OL. XCIII APRIL, 1931 APR 10 1931 No. 4

# ANNALS of SURGERY

A Monthly Review of
Surgical Science and Practice

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Official Publication of the American Surgical Association, of the New York Surgical Society and the Philadelphia Academy of Surgery

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. B. LIPPINCOTT COMPANY
NTREAL PHILADELPHIA LONDON

ANNALS of SURGERY

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# TUMORS OF THE CAROTID BODY

## REPORT OF TWELVE CASES INCLUDING ONE OF BILATERAL TUMOR*

By Fred W. Rankin, M.D.

DIVISION OF SURGERY,

AND

William L. A. Wellbrock, M.D.

SECTION ON SURGICAL PATHOLOGY,

OF ROCHESTER, MINNESOTA

THE MAYO CLINIC

Tumors of the carotid body, which are exceedingly rare, may give rise to few symptoms and yet demand formidable surgical procedures for their eradication. Two admirable reviews of the literature recently have appeared: one by Bevan and McCarthy, in 1929, reporting a case of their own and noting from the literature 133 other cases, and one by Talman, in 1928, noting 177 cases reported in the literature and adding a case of his own. Adding ours to this number, and six other cases, [3, 4, 7, 12, 13, 15.] which we have found in the literature, not reported by the authors named, brings the total to 196 cases.

Our interest was stimulated to review the cases at the Mayo Clinic by the occurrence of a case in which tumor of the carotid body was bilateral and in which operation was successfully performed. So far as we have been able to ascertain, this is the only case of bilateral tumor of the carotid body reported in the literature, in which the tumors appeared simultaneously, although Lund[10] mentioned a case in which a second tumor appeared in the opposite side of the neck twenty-nine years after removal of the first one.

The first anatomic description of this body was made by Von Haller[1] in 1743, under the name "ganglion minutum," and in 1797, Andersch described it as occurring at the bifurcation of the common carotid artery, terming it "ganglion intercaroticum." Luschka[1] added a description of the microscopic structure in 1862. The first description of a tumor of the carotid body in the American literature was that of Scudder,[9] in 1903. In 1906, Keen and Funke contributed a complete survey of the literature. Among the earlier cases reported were those of Da Costa[6] and Cathcart.[5] In 1881, Stieda[9] described the carotid body as a triangular collection of cells, connected by means of fine, fibrous strands with the oral epithelium on one end and with the thymus on the other. Embryologically, it is supposed to be derived from the epithelium of the pharynx, from the walls of the blood-vessels, from nerve tissue, or from the sympathetic ganglion cells of the carotid plexus. Physiologically, little is known of it. Indeed, it is not known whether it should be classified as fulfilling the function of an endocrine body or just

* Read before the Southern Surgical Association, December 9, 1930.

what function it exerts. In 36-millimetre embryos, this collection of cells is round and is no longer connected with the aforementioned structures; nevertheless Stieda maintained that the carotid body arises from them. In the sheep embryos, 10 to 11 millimetres in length, the body first appears as a thickening from the posterior portion of the horizontal branch of the branchial cleft, which is opposite the portion of the cleft from which the thymus develops.

The view that this body is of epithelial origin was supported by Rabl,[8] whereas Bonn[8] was inclined to believe that the structure develops in the accessory thyroid gland. Fischels[8] maintained that the embryologic origin of the carotid body is from the tissues lying between the approximately ectodermal and entodermal layers, denying, thus, its development from epithelial tissue. Katschenko[8] was the initial advocate of the view that the adventitia of the internal carotid artery near the bifurcation of the common carotid is the origin of the gland. This thesis is somewhat supported by the views of Arnold[8] and Waldeyer, and others. The first appearance of the structure in embryos 14 millimetres or more in length is of an ellipsoidal body composed of loosely woven, richly cellular connective tissue, and Paltauf[8] agreed with Katschenko that the anlage is connective tissue rather than epithelial tissue. Kohn[1] maintained that the body is distinctly neurogenic and that it develops from the embryologic ganglion cells of the intercarotid plexus, a view in which he supported the hypothesis of Luschka.[1] Marchand[8] also observed that in embryos of four months the body was surrounded by loosely woven connective tissue in which were many blood-vessels and nerves.

Anatomically, the glomus caroticum, or the ganglion intercaroticum, is an ovoid body, approximately 5 millimetres long, 3 millimetres wide, and 1.5 millimetres thick. Its customary situation is the median and deep aspects of the upper end of the common carotid artery at its bifurcation into the internal and external trunks. Occasionally, it is found distinctly on the posterior side of the bifurcation. It is a firm body, of grayish or brownish color, with a distinctly fibrous capsule, and contains a hilum at which its arterial blood supply enters. Capsular prolongations into the body itself divide it somewhat indistinctly into lobules, which, in turn, are further subdivided by delicate strands and capillaries, forming alveolar spaces which contain the cellular elements. The capillaries have been described by some as almost sinusoidal; they are of large diameter, but thin-walled. There is, with increasing age, a piling-up of connective tissue and an increase in the number of blood-vessels, at the expense of the epithelial elements. Finally, as the person grows into adult life, the carotid body undergoes changes which eventually make it recognizable as a distinct anatomic structure. The characteristic cellular elements which distinguish it are the polygonal cells. Their protoplasm is finely granular, and the nucleus, which is ovoidal and comparatively large, contains a small amount of chromatin. Some cells which are found in the stroma and the lobules stain brown when treated with chromic acid. To these chromaffin cells Mulor[8] attributed an important functional

significance, calling attention to the fact that similar cellular elements are observed in the suprarenal glands, coccygeal body, the hypophysis cerebri and the abdominal sympathetic ganglia.[2, 11] Marchand [8] postulated that although the structure of the gland is difficult to determine, it is composed of two essential elements: Blood-vessels and cells. In the lobules the branches form capillaries, producing a pattern which conforms to the structure of the gland, as described by Arnold,[8] who mentioned that the essential part of the carotid body consists of the glomeruli which are formed by the capillary network. The polyhedral or ovoidal cells are intimately related to the blood-vessels, so much so, in fact, that Marchand was strongly inclined to regard them as derivatives of the capillaries.

When tumors affect this body, they become lobulated or globular and sometimes take on the appearance of a small kidney when they grow to sizable proportions. If they remain globular, they may push up into the notch of the carotid vessels, increasing the angle, and finally may advance forward to lie on the vessel. The consistence is increased and the mass is firm, usually, although occasionally it may be brain-like to the touch. The tumors are always encapsulated and resemble somewhat, when removed, fœtal adenomas or tumors of the parathyroid gland, although blood-vessels are a conspicuous element in their make-up and are observed in all parts of the capsule abundantly.

*Pathology.*—Pathologically, these tumors are often designated by such names as "adenoma," "endothelioma," "perithelioma," "paraganglioma," "neuroblastoma," "sarcoma," and simply "carotid body tumors." The last term seems a sensible one until pathologists are able to agree on a better term. Paltauf[8] suggested "perithelioma" as the most common pathologic type among these tumors on account of their origin. The tumor cells contained in the alveoli are without definite arrangement and sometimes are positively malignant, infiltrating the walls of the vessels and the surrounding tissues, and yet slow-growing and almost invariably without a tendency to metastasize. However, in Gilford and Davis' case, metastasis was into the liver, but these authors questioned the validity of the diagnosis and noted another patient of Moenchenberg, who died of papillary adenosarcoma of the ovary after removal of the carotid body. Two of the patients in the group reported from The Mayo Clinic returned with possible metastasis to the brain; one patient had symptoms of a brain tumor and the other of epilepsy, but these conditions were not verified by necropsy. Lund mentioned one case in which metastasis to the liver was found at necropsy. With the exception of these cases, distant metastasis has not been noted, although occasional observers have reported cases which involved the regional lymphatic structures. Bevan and McCarthy noted that in 17 per cent. of the whole group, definite malignancy had occurred in the tumors of the carotid body, and that nearly 9 per cent. of the patients had definite recurrences. Malignancy, however, is uncommon. The recent articles in the literature, which have been reviewed thoroughly, agree that about 80 per cent. of tumors of these bodies

are benign and that about 20 per cent. are malignant. Careful analysis of all reported cases, as our experience in the clinic has verified, will indicate that many tumors, called tumors of the carotid body, are, in reality, not carotid tumors at all, but belong to some other group of malignant growths of the neck.

The general structure of the tumors of the carotid body described is nearly always the same. The epithelial cells are packed in an endothelial-lined alveolus, the size of which varies in different tumors. In our case of bilateral tumor, one growth was composed very strikingly of this alveolar arrangement, whereas, on the opposite side, it was almost absent. The first tumor looked like an adenoma or like hyperplasia of the body, whereas the other tumor had somewhat the character of a neurofibroma.

The characteristic structure of a tumor of the carotid body is that of an alveolar perithelioma, with its whorls or *zell-ballen*. The cells are polyhedral and granular, and are arranged in compact groups, with or without lumens surrounded by endothelium. Some tumors are vascular, due to the numerous large vessels and blood spaces, lined by prominent endothelial cells, which sometimes protrude into the lumens in masses. The amount of stroma varies; in some it is scant and in others it is dense.

Because of lack of definite knowledge as to the character of these tumors, we have classified our cases as examples of benign and malignant tumors of the carotid body. We have considered as malignant those in which there was much variation in size of the cells: Large, single, or multiple hyperchromatic nucleoli; the presence of mitosis, and invasion of the tumor itself into its capsule.[14]

*Symptoms.*—The paucity of symptoms in the early stages of tumor of the carotid body is characteristic. Usually the patient notes a lump in the neck which is symptomless and scant attention is paid to it. The mass is movable, frequently, and varies in size from a small tumor which is freely palpable, to one like that which appeared in our case in which the mass was bilateral and about 7 centimetres in diameter. As the mass enlarges, usually pulsation is observed through it because of its attachment to the blood-vessels, and this false symptom makes its distinction from an aneurism of the carotid artery, or of one of its branches, essential. The type of pulsation noted, because of the close association of the tumor with the free carotid vessels, is an interesting phenomenon. Almost always this pulsation is present but it lacks the expansile quality of an aneurism, and although there is no pathognomonic symptom, this pulsation is typical. Rarely are there associated symptoms, such as the thrill and bruit which are produced by aneurismal masses. The mass may be grasped and moved from side to side, and the skin is not attached over it. Differential diagnosis usually is difficult and frequently is not made correctly. Aneurism of the carotid vessels probably is the first thought presenting itself, but some type of lymphoma, lymphosarcoma or tuberculous invasion of the lymph nodes of the neck must be eliminated. Lesions of the thyroid gland, and branchial cleft cysts likewise have to be

considered, but most often the tumor can be distinguished from these. In the early stages the tumor is mobile and remains so until it becomes attached to the surrounding tissues, when symptoms of pressure occur. Pain is conspicuous by its absence, and is rarely noted, and tenderness to palpation is not observed. Vagal pressure, causing fainting spells, is not uncommon and in three cases which were reported the Stokes-Adams' syndrome was present. Interference with the recurrent laryngeal nerve causes, in a great many instances, hoarseness and other changes in the voice, dysphasia, dyspnœa, and so forth. The astonishing length of time over which some of the tumors persisted, which were found later to be tumors of the carotid body, indicates the proneness of these tumors to be benign rather than malignant. In some of the cases, the condition had persisted for as long as thirty-five years or more.

Among our twelve patients there were seven women (58.3 per cent.), and five men (41.6 per cent.). The ages ranged from twenty-three to sixty-eight years. Usually the tumors occur in middle life, in the third or fourth decade, although this is by no means uniform and many patients are younger. The youngest patient, according to Bevan and McCarthy, was aged seven years. We have not been able to obtain the report of this particular case but Sinyshin reported the age of one patient as nine years.

The diagnosis is rarely made pre-operatively. Only when the tumor is uncovered and microscopic examination confirms the suspicion that there is a tumor at the bifurcation of the carotid artery is this rare entity identified.

The magnitude of the surgical procedure for removal of tumors of the carotid body is influenced, in the main, by the necessity of ligation of one, two or three carotid vessels. The densely adherent tumor, which affixes itself in the carotid notch in such a manner as to make its dissection impossible without removal of some of the carotid vessels, is removed with difficulty and danger in proportion to the patient's age and the necessity of sacrificing not only the carotid vessels but adjacent structures, such as the cervical lymphatic apparatus, or the vagus nerve. The latter may be resected without much additional risk, but increase in the difficulty may be sufficient to increase the mortality. Ligation of the common carotid artery in adults, particularly those who are in the latter half of middle age and beyond, is an extremely serious procedure, which carries with it a high rate of mortality, well recognized by all surgeons, ranging from 30 to 65 per cent. In our series of cases it was necessary to ligate the common carotid artery in three, and all of these patients succumbed in the first forty-eight hours. The external carotid artery of other persons was ligated twice but without undesirable sequelæ or fatality. The tumor was excised in all of the cases. Of the nine patients who survived the operation, seven are living and well. In eleven of our cases, five tumors were found to be malignant and six benign at the time of operation. In the case in which the tumors were bilateral that of the left side was found to be malignant and that of the right, benign, making a total of six malignant and seven benign tumors of the carotid body.

ABSTRACTS OF THE TWELVE CASES OBSERVED AT THE MAYO CLINIC

CASE I.—A woman, aged thirty-four years, had noted enlargement of the thyroid gland for fifteen years. There had been no noticeable increase in size in the six years previous to her admission. Operation was performed April 5, 1913, and revealed multiple thyroid adenomas and also a mass, which was adherent to surrounding structures, lying high in the neck, toward the angle of the jaw. The pathologic diagnosis was malignant tumor of the right carotid body, measuring 7 centimetres, 5 centimetres, and 4 centimetres in various diameters, associated with multiple adenomas of the thyroid gland. The patient died in August, 1913, in a condition of paralysis. In this tumor there were masses of epithelioid cells lying in an endothelial stroma. Many mitotic figures were present.

CASE II.—A woman, aged fifty-three years, had had a lump in her neck for six years. It had increased slowly in size and had produced local symptoms of pressure. The clinical diagnosis was probable cyst. Operation was performed January 19, 1915. The pathologic diagnosis was benign tumor of the right carotid body, measuring 6 centimetres, 2 centimetres, and 2 centimetres in various diameters. The patient died January 23, 1915, of thrombosis of the middle cerebral artery. The tumor consisted of numerous, small, whorl-like masses of epithelioid cells lying in endothelial-lined spaces. The stroma was rather heavy, consisting of fibrous hyaline tissue.

CASE III.—A man, aged twenty-six years, first noticed a lump seven years previous to his admission; it grew slowly and then decreased in size three years later with massage. The clinical diagnosis was lymphocele (70 per cent.) and carotid body tumor (30 per cent.). Operation was performed March 17, 1915. The pathologic diagnosis was malignant tumor of the left carotid body. The patient returned in 1925 with epilepsy, which had been present for the previous four months. A gangrenous appendix and the tonsils were removed in 1925. The tumor was composed of groups of epithelioid cells lying in endothelial-lined spaces, and also large, whorl-like bodies. In certain regions there was a papillary appearance, with larger, deeply-staining cells in dense, fibrous connective tissue, and with some invasion of the capsule of the tumor.

CASE IV.—A woman, aged forty-five years, first noticed an enlarged gland in the right side of the neck in 1913. At that time she had earache and pain through the face. She had had influenza in 1918, with pain in the cheek bones, over the eyes, and in front of the ears. Following this, jaundice, with pain over the liver, appeared. A painless lump appeared under the right jaw and gradually enlarged. In the six months previous to her admission at the clinic she had lost fifteen pounds in weight. The clinical diagnosis was post-influenzal tuberculosis. Operation was performed February 12, 1919. The pathologic diagnosis was as follows: Tumor from bifurcation of carotid artery, malignant tumor of the carotid body; cellular tumor with tendency to form *zell-ballen* but little true formation of them; cells varying in size, with many containing prominent, deeply-staining nuclei, and some cells with multiple nuclei. By September, 1919, recurrence had not taken place.

CASE V.—A woman, aged fifty-two years, had a lump on the left side of the neck, about 2.5 centimetres in diameter and of unknown duration. She also had a branched renal stone. Operation was performed August 20, 1919. The pathologic diagnosis was benign tumor of the carotid body, 3 centimetres, 2.5 centimetres, and 5 centimetres in various diameters. The patient died on the day following operation from hæmorrhage. The tumor was composed of many small, whorl-like masses of epithelioid cells. Scattered in the stroma were a few of these cells.

CASE VI.—A man, aged sixty-eight years, had had a tumor of the right side of the neck for eight years previous to his registration at the clinic. He remembered having a small kernel at the angle of the jaw thirty-two years previously. It had not enlarged until he had the "grippe." The clinical diagnosis was tumor of the carotid body or mixed tumor of the salivary gland. Operation was performed September 20, 1920. The pathologic diagnosis was benign tumor of the carotid body, 7 centimetres, 6 centi-

metres, and 4 centimetres in various diameters. The patient died five days following operation, of bilateral bronchial pneumonia and softening of the brain. The tumor consisted of epithelioid masses arranged in radial fashion and also in the characteristic whorls. There were many cells of variable size and deeply-staining nucleoli.

CASE VII.—A woman, aged thirty-five years, had had a growth, about 2.5 centimetres in diameter, at the right angle of the jaw for one year. It did not increase in size and there were no symptoms. Operation was performed August 15, 1921. The pathologic diagnosis was malignant tumor of the carotid body, composed of a large number of masses and whorls of epithelioid cells, with a tendency to invade the capsule. The patient returned in August, 1930, complaining of dizziness, headache, black spots before the eyes, and stiffness of the muscles of the neck. She had had a lump in the right thigh for one month which proved to be a fibrosarcoma.

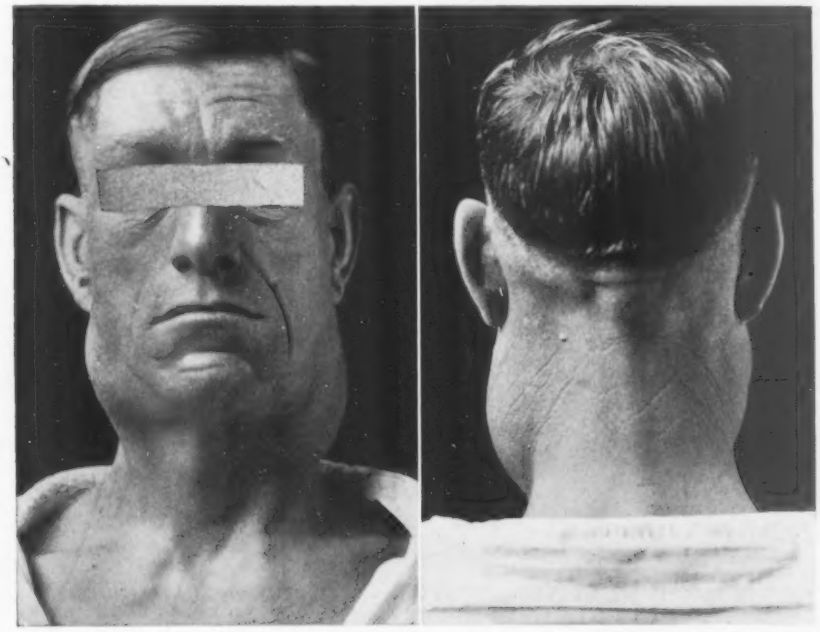

FIG. 1.—Bilateral tumors of the carotid body.

CASE VIII.—A man, aged thirty-eight years, first noticed a small lump on the right side of the neck two and a half years previous to his registration at the clinic. It increased in size. Tonsillectomy was performed. Some aching and soreness occurred. The clinical diagnosis was branchial cyst or tuberculous glands. Operation was performed March 21, 1923. The pathologic diagnosis was benign tumor of the carotid body 6 centimetres, 4 centimetres, and 3 centimetres in various diameters. The tumor consisted of rather heavy fibrous, hyaline tissue, containing a few collections of epithelioid cells lying in endothelial-lined spaces, and it contained many of the characteristic, whorl-like masses.

CASE IX.—A woman, aged thirty-six years, first noticed an "enlarged gland" on the right side of the neck in 1922. Following tonsillectomy it disappeared for six months. Three months later the lump again appeared. The clinical diagnosis was branchial cyst or tuberculous glands. Operation was performed July 29, 1924. The pathologic diagnosis was benign tumor of the carotid body 4.5 centimetres, 3 centimetres, and 2.5 centimetres in various diameters. The tumor consisted of large masses of

epithelioid cells arranged in radial fashion, without any definite whorls, producing the appearance in cross section of a papillary tumor of the urinary bladder.

CASE X.—A man, aged thirty-seven years, had a tumor of the left side of the neck of four years' duration. Just previous to his registration at the clinic, it had increased in size more rapidly than formerly. He refused treatment, but returned five years later, at which time the tumor had increased considerably in size, and had encroached on the pharynx and hypopharynx. Operation was performed March 27, 1925. The pathologic diagnosis was malignant tumor of the carotid body, 6 centimetres, 5 centimetres, and 3 centimetres in various diameters. By 1927 there was no recurrence. The tumor was composed of groups and of many whorl-like masses of epithelioid cells lying in endothelial-lined spaces. Scattered in the stroma were epithelioid cells of various sizes. An occasional mitotic figure was present and there was a tendency of the tumor to invade the capsule.

CASE XI.—A woman, aged forty-nine years, had a mass in the left side of the neck, attached to underlying structures and not producing symptoms. She had a stone in the ureter. The clinical diagnosis was branchial cyst. Operation was performed December 3, 1926. The pathologic diagnosis was benign tumor of the carotid body, 4.5 centi-

FIG. 2.—Tumor of carotid body, right side, 5 centimetres, 4.5 centimetres, and 3 centimetres in various diameters. The weight was 35 grams. The tumor was oval, encapsulated, semisolid, and reddish-gray.

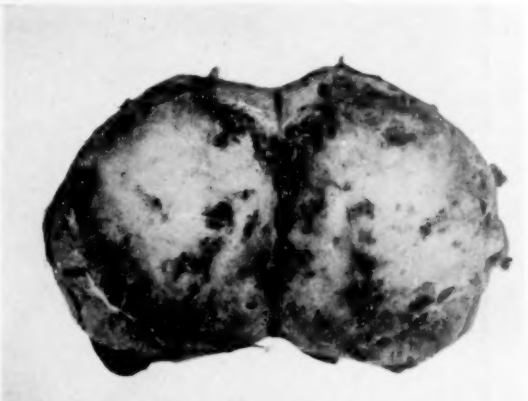

FIG. 3.—Tumor of the carotid body, left side, 7 centimetres, 6 centimetres, and 6 centimetres, in various diameters. The weight was 85 grams. The tumor was encapsulated, grayish-brown, spongy, and œdematous, with cystic, hæmorrhagic portions. The centre was firmer, and yellowish-brown.

metres long and 2 centimetres wide. The tumor was composed of solid masses of epithelioid cells and whorl-like structures of similar cells lying in endothelial-lined spaces, clothed in a fibrous capsule.

CASE XII.—A man, aged forty-nine years, registered at the Mayo Clinic in June, 1929. He came because of swelling on both sides of the neck (Fig. 1) which he first had noticed as nodules about 1 centimetre in diameter, ten years previously. He had had an attack of parotitis seven years previously which had lasted three days. Both nodules increased in size slowly until, at the time of removal, they appeared as rather soft tumors, about 4 to 7 centimetres in diameter, the larger of which was on the left side. The tumor removed from the right side (Fig. 2) measured 5 centimetres, 4.5 centimetres, and 3 centimetres in various diameters, and weighed 35 grams. It was oval, encapsulated, semisolid, and of a reddish-gray color. On section it was semisolid, homogeneous, dark reddish-brown, and had the appearance of an undifferentiated fœtal adenoma of the thyroid gland. The tumor removed from the left side (Fig. 3) measured 7 centimetres, 6 centimetres, and 6 centimetres in various diameters and

weighed 85 grams. It was oval, encapsulated, and on section it was grayish-brown, spongy, and œdematous, with cystic hæmorrhagic portions, varying in size. In the centre, it was firmer, and the color was yellowish-brown.

Microscopically, the tumors were composed of blood spaces, varying in size, and

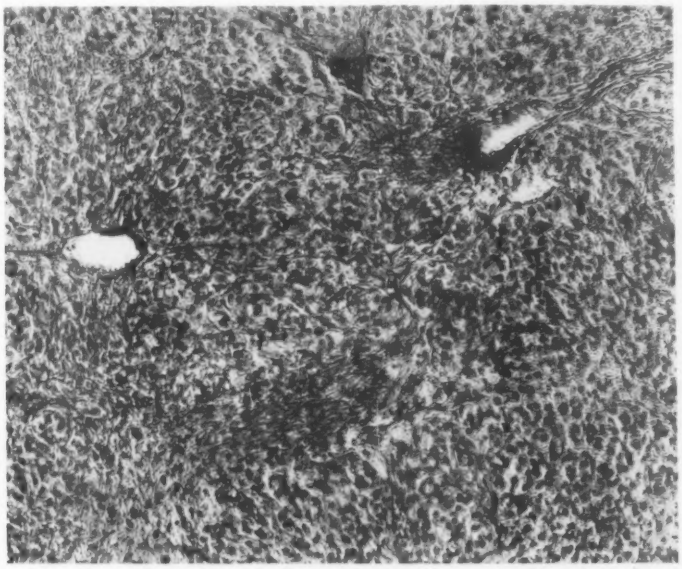

FIG. 4.—Microscopic picture of tumor from the right side. Diffuse epithelioid cells lay intermingled in the endothelial connective tissue; also, there were many larger, irregular spaces.

alveoli lined by endothelium containing large, polyhedral cells with large, oval nuclei, with deeply staining, coarse and fine granular protoplasm. In the unfixed tissue, stained by polychrome methylene blue, these cells closely resembled those present in adenomas

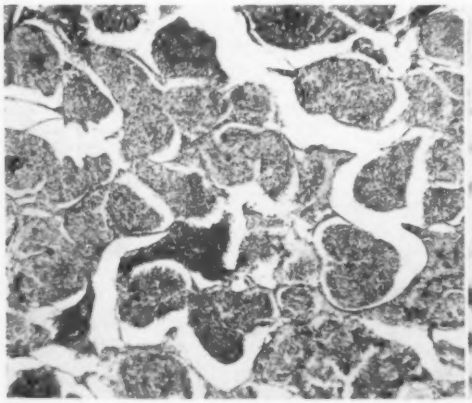

FIG. 5.—Microscopic structure of most tumors of carotid body. The characteristic perithelial or whorl formations in the tumor of the left side.

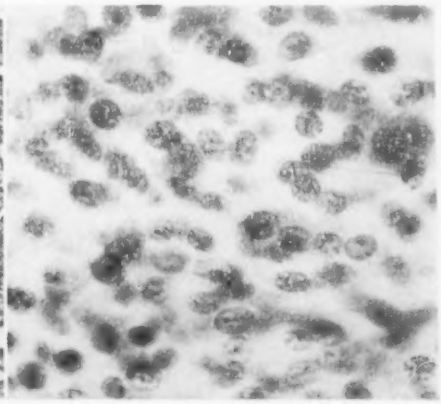

FIG. 6.—High-power magnification of cells composing epithelial element or tumors of the carotid body. Rather dark, granular protoplasm is present (x900).

of the parathyroid gland. However, the histologic design distinguished this tumor from other similar tumors. Many of the alveoli were reinforced by connective fibrous tissue.

The cells which composed the tumor on the right side (Fig. 4) lay in a rather diffuse, fibrous, endothelial stroma and also in whorl formation. In this tumor there

was very little of the alveolar structure so characteristic of tumors of the carotid body, whereas, on the left side (Fig. 5), the predominant feature was the alveolar arrangement. The cells varied in size and had poorly defined outlines. In some there was a suggestion of a spinous process, giving the appearance of a nerve cell. The nuclei were oval or round, varying in size; some were very large. The nucleoplasm was finely and coarsely granular, and stained from a pale pink to a deep purple. Occasionally there was seen a deeply-staining, prominent nucleolus and a mitotic figure (Fig. 6). Fresh sections, stained with polychrome methylene blue, and fixed sections stained with hæmatoxylin and eosin were studied. Special staining was not done; therefore, the presence or absence of chromaffin cells was not determined.

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# SURGERY OF THE PHRENIC NERVE IN TREATMENT OF INTRACTABLE HICCUP

By Carnes Weeks, M.D.

of New York, N. Y.

FROM THE FIRST SURGICAL DIVISION OF BELLEVUE HOSPITAL

One of the most distressing post-operative complications in abdominal surgery is intractable hiccup. It may be mild, yielding to the simpler forms of treatment, or it may be extremely severe with interference of respiration and deglutition. There is no doubt that in the severe form the patient can and will gradually go down hill and die from exhaustion.

It is the purpose of this paper to describe the course of a case of intractable hiccup appearing in a patient who had been operated on for a perforated duodenal ulcer. The usual medical treatment for hiccup having failed over a period of eleven days, the phrenic nerve was crushed with permanent relief of the condition. Only temporary relief was previously obtained with novocaine block and traction.

Case I.—The patient, forty-one years of age, a male telephone operator, was admitted to Bellevue Hospital with a diagnosis of perforated duodenal ulcer. He was operated on within a few hours and the perforation closed. He ran a post-operative temperature of 102° to 103° F. for five weeks. The origin of this fever could not be determined. Thirty-nine days post-operative he developed signs of a right lower lobe pneumonia which were confirmed by X-ray.

At this time the patient complained of severe hiccup. This complication continued without intermission both day and night for eleven days. All the usual remedies were tried without the slightest success; ether injections, inhalation of carbon dioxide, tracheal compression, digital compression of the phrenics, and injections of large doses of morphine and hyoscine.

The patient was gradually going down hill from exhaustion. He was cyanotic, his pulse was weak and rapid. There was considerable difficulty in swallowing and moderate dyspnœa. The cause of the hiccup was thought to be a diaphragmatic pleurisy of the right side, causing reflex stimulation of the right phrenic nerve. Therefore, under a local anæsthetic, the right phrenic nerve was exposed and isolated in its course on the scalenus anterior. The rate of hiccup at the beginning of the operation was twenty-two times per minute. Two cubic centimetres of 1 per cent. novocaine were injected into the nerve. The hiccup stopped immediately for the first time in eleven days with great relief to the patient.

As it was thought that the novocaine block would merely afford temporary relief, a stout silk ligature was passed about the nerve, the ends brought out of the wound and attached with adhesive tape to the skin. The wound was then closed. Eight hours later the hiccup recommenced, the effect of the novocaine having apparently worn off. The rate of hiccup now was sixteen times per minute.

Traction was then exerted on the nerve by means of the silk ligature and immediately the hiccup stopped. During the night, for a period of eight hours, traction was used three times due to return of the hiccup. Relief from this method lasted about two hours.

As neither anæsthetization nor traction gave permanent relief, the nerve was pulled into the reopened wound and crushed with a stout clamp. Following this procedure there was complete and permanent relief of the hiccup. Fluoroscopy at this time showed an immobile right diaphragm.

The further course of the patient displayed a continued temperature. X-ray examinations made during the next few weeks showed a spread of his pulmonary lesion characteristic of tuberculosis. His sputum became positive for tubercle bacilli. He ran a downward course and died three months post-operative, of his tuberculosis.

The experimental evidence obtained in this case as to the blocking of nerve impulses through the phrenic nerve is worthy of emphasis. Two cubic centimetres of 1 per cent. novocaine controlled spasm of the right side of the diaphragm for about eight hours. The same result for two hours was obtained by moderate traction of the nerve.

Hiccup is an extremely complicated mechanism that is far from being fully understood. The characteristic sound of hiccup is produced by a spasm of the diaphragm causing a sudden inspiratory movement with closure of the glottis. Apparently in the milder forms of hiccup the diaphragm is the chief respiratory muscle involved. However, in the more severe forms some or all of the accessory muscles of respiration may be involved.

These groups of muscles apparently have a common centre of control: the respiratory centre in the medulla. This centre is subject to numerous reflex stimuli. It may respond to stimuli from the mouth, pharynx, larynx, lung, skin, gastro-intestinal tract and diaphragm. It is undoubtedly acted upon by certain toxic products in the blood as in the hiccup of uræmia from chronic nephritis.

It seems probable in the case just reported that the diaphragmatic pleurisy caused a reflex stimulus of the phrenic nerve on that side. That the phrenic nerves contain sensory fibres we know because of the pain experienced by the patient during phrenic resection.

In every case of hiccup in which there is spasm of the diaphragm, it seems logical to believe that this spasm can be relieved by interrupting the course of nerve impulses through the phrenic nerves. However, when the hiccup includes the other muscles of respiration, which are numerous, then crushing or avulsion of one or both phrenics may not give complete relief.

Case II.—*Bilateral Phrenic Avulsion.* Woman aged thirty-five, a singer by profession. Admitted to the French Hospital January 16, 1931, service of Dr. H. C. Falk. Complaining of persistent hiccup of five years' duration. The only occasions during this period when there was cessation of the hiccup were during sleep.

The patient gave a history of an attack of grippe five and one half years before, which lasted some few months and was followed by typhoid fever. Soon after this the patient underwent a severe mental shock. The hiccup apparently started in the train of these events.

The woman is in apparently excellent health, but extremely neurotic. The hiccup occurs about 5 to 10 times per minute with severe attacks in which the rate rises to 140 times per minute. On fluoroscopy both sides of the diaphragm appear to be involved.

The etiology is extremely difficult to determine. Whether we are dealing with a post-encephalitic hiccup or one of an hysterical nature, it is impossible to say. This

patient had undergone for five years all the usual procedures for the relief of hiccup, with no results. On this admission avertin anæsthesia had to be given on nine different occasions to allow the patient some rest. As a last resort bilateral phrenic avulsion was done February 11, 1931, under local anæsthesia.

The patient hiccupped for about one hour the evening of the operation day; twelve times the second post-operative day, and since then has been entirely free from this complaint.

Phrenicotomy is an operative procedure attended with but little risk and certainly seems justifiable in those cases of severe hiccup in which the patient's life is endangered. This operation is today frequently performed in the treatment of chronic pulmonary tuberculosis. In the treatment of hiccup it becomes an emergency measure.

The relation of the phrenic nerve to hiccup was recognized at least as early as 1833 by Doctor Shortt[1] of Edinburgh who recommended blistering the surface of the neck over the origin and course of the phrenic nerves for intractable hiccup. He reported several successful cases treated in this manner.

Digital compression of the cervical portion of the phrenic is a common method of controlling hiccup and its successful use reported by Grognot,[2] 1885, and Leloir,[3] 1892.

Galvanic and faradic currents applied to the region of the phrenic nerves have been used and reported successful in the treatment of hiccup by Capriati,[4] 1898, and Regis and Debedat,[5] 1897.

It was not, however, until after Stuertz[6] and Sauerbruch[7] in 1911 demonstrated the possibility of an artificial paralysis of the diaphragm by section of the phrenic nerve that actual surgery was used to prevent hiccup.

In 1917 Kroh,[8] at a meeting of military surgeons, reported the successful novocaine treatment of ten cases of severe hiccup resulting from dysentery. He injected 10–20 cubic centimetres of a 1 per cent. novocaine slution into the scalenus anterior muscle three fingers above the clavicle at the outer border of the sternomastoid.

Goetze,[9] 1920, performed a temporary phrenic block in a young patient attacked by hiccup after appendectomy. He used the same technic as Kroh although independently. He was of the opinion that the anæsthetization lasts two to three hours. In the author's case anæsthetization lasted eight hours, but here 2 cubic centimetres of 1 per cent. novocaine were injected directly into the nerve.

Erkes,[10] 1921, reports bilateral injection in post-operative gastro-enterostomy hiccup of seven days' duration with relief.

Kummel[11] did novocaine injections in post-operative hiccup with success.

Payr[12] reported a left-sided injection with instant success.

Ghose,[13] 1926, reports a case of hiccup of four months' duration stopped with 1 per cent. novocaine injection, 2 cubic centimetres into both phrenics.

Jirasek,[14] 1925, reports a case of hiccup of ten days' duration cured by bilateral anæsthesia of the cervical sympathetics. He believes the sympathetic afferent portion of the phrenic nerve chiefly involved in hiccup. Because the sympathetic nerve conducts stimuli to the respiratory centre in reflex hiccup in cases involving all respiratory muscles or the diaphragm without them, he suggests severing the cervical sympathetic nerve at the cervical spot of phrenicotomy. He believes that bilateral phrenic avulsion is harmless in those not having exclusive abdominal respiration.

Actual section of the phrenic nerve was done in 1915 by Kroh, not for relief of hiccup, but for tetanic spasm of the diaphragm during tetanus, with complete success.

Kroh,[15] 1921, reported a case of a man forty-two years of age who had suffered for seven months from violent intermittent hiccup which persisted during sleep. Both phrenic nerves were injected with novocaine. The hiccup subsided and the patient went home, but returned in two weeks worse than ever and urging an operation. A right phrenicotomy was performed with temporary relief for three weeks; a left phrenicotomy was done without result; finally avulsion of the left phrenic was done with complete cure.

Kroh,[16] 1922, reported another successful case. He first tried bilateral novocaine injection for intractable hiccup with no success; he then did bilateral avulsion with a complete cure. The patient complained for several weeks of some dyspnœa on climbing upstairs or sleeping on his back. These symptoms, however, later cleared up.

It undoubtedly will not be successful in every case, as is evidenced by a few reports in the literature. Kappis,[17] 1924, reported bilateral phrenic avulsion in a woman who had previously had elsewhere bilateral phrenicotomy for hiccup of three years' duration. The hiccup, however, persisted. Physical examination showed no active participation by the diaphragm during hiccup, but a clonic contraction of the bilateral cervico-clavicular-thoracal muscles.

Lehmann[18] reports a case of post-encephalitic hiccup in a woman twenty-seven years old. This condition had persisted for two years in spite of morphine, scopolamine medication, hypnosis, novocaine injections into the phrenic nerve, faradization of the phrenics and finally bilateral phrenicotomy. Except when talking or sleeping the patient hiccupped forty times per minute. She requested a renewed operation. Bilateral phrenic avulsion was then done. X-ray showed complete bilateral paralysis of the diaphragm. Two days post-operative the hiccup returned accompanied by extreme dyspnœa that required laryngeal intubation. She gradually recovered but the hiccup returned.

From these failures we learn that the chance of cure with phrenic avulsion, in those cases in which the hiccup involves not merely the diaphragm but all muscles of respiration, is not very good. However, these people are willing to do almost anything, and if there is a slight chance of success, then phrenicotomy should be done.

Oehler,[19] 1922, reports a failure in a patient, a man, aged thirty-eight, recovering from a gastro-enterostomy, after resection of 1 centimetre of each phrenic nerve. The patient committed suicide. This was threatened by the author's patient unless relief was given.

We believe that failure should not be admitted following resection of a small piece of each nerve, but only after bilateral avulsion has been done. The reason for this is the frequent anastomosis of the phrenic with other nerve fibres below the point of resection, thus allowing nerve impulses a roundabout pathway to the diaphragm.

Dowman,[20] 1927, reports the relief of diaphragmatic tic following encephalitis by bilateral section of the phrenic nerves. The feature of this case was rapid breathing of a pure abdominal type, the rate being 130 a minute. On fluoroscopy there was a fluttering of the diaphragm, the contractions varying from 90 to 130 a minute. There was no evidence of thoracic movement. The right phrenic nerve was cut and the left frozen with ethyl chloride. Cutting the right phrenic had no influence on the rapid breathing, but as soon as the left phrenic was frozen the respiratory rate fell to twenty a minute, and the character of respiration changed from abdominal to thoracic type. The patient returned two months later with a respiratory rate of ninety. Fluoroscopy showed an

immobile right diaphragm and fluttering of the left. The left phrenic was then divided with the respiratory rate dropping to twenty and complete cure.

Interest in this case centres on the apparent safety in cutting both nerves.

Freezing of the nerve with ethyl chloride has been done by Kroh,[16] Kuttner,[21] Goetze,[9] and others with some success. The effect apparently is of longer duration than that obtained in the novocaine block.

Steinke[22] in 1930 suggested traction on the phrenic nerve by means of a heavy silk ligature as a method of treatment for severe hiccup.

The plan carried out in the case just reported seems to be the most logical one. In intractable hiccup if all the usual methods of treatment fail, the patient should be fluoroscoped to determine which side of the diaphragm is involved. The phrenic nerve on the side involved should then be exposed under local anæsthetic and a stout silk ligature passed about it. The nerve can then be anæsthetized. This effect apparently lasts about eight hours. Following this, traction should be tried, and if it fails the nerve can easily be exposed and crushed. If at the time of operation, novocaine block and traction both fail, it should lead one to believe that there is nerve anastomosis below the site of section or blocking and the nerve should then be avulsed. If both sides of the diaphragm are involved, then both phrenics should be exposed and blocked either temporarily or permanently.

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# TRENDELENBURG'S OPERATION FOR PULMONARY EMBOLISM

## REPORT OF A RECENT ADDITIONAL CASE

By Anders Westerborn, M.D.

of Uppsala, Sweden

FROM THE SURGICAL CLINIC OF THE UNIVERSITY HOSPITAL OF UPPSALA

In the Annals of Surgery, 1930, vol. xcii, No. 4, p. 498, Prof. Gunnar Nyström reported the cases of pulmonary embolism operated by him in the surgical department of the University Hospital in Uppsala. Since the publication of this paper, another case of the kind has been operated at the clinic. The embolus was successfully removed in this case also, and the circulation reëstablished, but the patient succumbed next day to a new embolus. Since it is important, as Nyström points out, to report all operated cases of pulmonary embolism in order to widen our knowledge and aid us in determining the indications, the technic of operation and the prognosis, I feel justified in relating this case, although its outcome was fatal, especially since so few cases have hitherto been reported. According to Nyström, only fifteen* cases are reported in the literature, and of these, seven were definitely cured, while the remaining eight survived the operation only a short time. The case reported herein is thus the sixteenth published one to survive operation.

Case.—Surgical Clinic Uppsala, 1930, No. 1634, married woman, aged fifty-eight. Patient rather corpulent. Had been in bed with fever up to 39.5° C. since June 2 with symptoms of cholecystitis. Good general condition. Cholecystectomy June 13. A stone the size of a thumb's end was found in the collum vesicæ felleæ. The first days after the operation the general condition of the patient was rather low, owing to a severe cough with much expectoration. June 18, five days after operation, her condition had improved, but the temperature still ran as high as 38-38.4° C., with a pulse rate of 80. As yet no clear symptoms of thrombosis. On this day, however, the patient had queer sensations in her left leg. She felt as if something were running in the leg. Some minutes later she fell back in her bed cyanotic, could give no answers to questions, and her pulse was no longer to be felt. The nurse at once made the diagnosis of embolism of the pulmonary artery. She therefore had the patient sent to the operating room at once, without awaiting the arrival of the surgeon on duty. When he arrived, the patient was unconscious; no pulse, respiration stertorous of pre-agonal type.

The operation was begun at once, at 3:40 P.M., without disinfection of the hands, the operator merely putting on sterile clothing and rubber gloves. The time between the onset of the alarming symptoms and the beginning of the operation cannot have exceeded four minutes.

*Operation* (Westerborn).—The incision was made without anæsthesia. No bleeding from the wound. Resection of the second and the third ribs. In the resection of the third rib, the parietal pleura was injured. The opening was occluded with a tampon. After the pericardium had been opened a rubber tube was placed around the aorta and the pulmonary artery. An incision of 10–12 millimetres was made in the wall of the

* By overlooking in reproducing the manuscripts, two cases in Nyström's list of surviving cases have fallen away. One case of Meyer's, dead of new pulmonary emboli twenty-five days after the operation, and one case of Crafoord's, discharged healed.

latter after strangling the vessel by tightening the above-mentioned tube. The wound gaped without the use of retractors. With a forceps, a large embolus was extracted from each main branch of the artery. When the forceps was reintroduced into the lumen no further emboli were found, nor was there any thrombotic mass to be withdrawn by suction. The incision in the wall of the artery was closed with a clamp and the traction on the rubber tube was released. The vessel had probably been compressed 70–80 seconds at the most.

When the thoracic cavity was opened, the heart beat quite feebly; only fibrillar twitchings could be observed. Immediately after the release of the mechanical hindrance the heart stood absolutely still, but on the injection of adrenalin into the aorta it began to move and very soon normal contractions appeared. The suture of the wound in the artery was rather difficult, the artery clamp having been placed very near the edge of the wound so that the sutures cut through. After readjustment of the clamp, the wound was perfectly closed and no blood escaped. Suture of the pericardium and the opening in the pleura. Skin suture. The internal mammary artery was covered.

The circulation had steadily improved after its reëstablishment through the lungs, but not until the skin was sutured did the patient give any manifestations of pain. She did not answer questions, and did not regain consciousness until after she had been brought back to bed and the foot of the bed had been elevated. After an hour or so she was quite clear in her mind but for the next hour she was totally blind. At 7 o'clock in the evening her sight was normal and her pulse good. She recognized her surroundings and talked easily. Her breathing, however, was rather forced. Air was therefore aspirated from the left pleural cavity after which the respiration became quieter. During the night her condition was very good, she was mentally clear and her pulse calm. At 6 o'clock in the morning she became acutely worse; there was no palpable pulse, cyanosis and mental confusion. Exitus at 7:50 A.M.

The autopsy showed a large embolus obstructing the right branch of the pulmonary artery. Its size and position in the ramification of the vessels exclude the possibility of its having been overlooked at the operation. The embolus was somewhat adherent to the arterial wall. The place at which the artery had been sutured showed no thrombi. Both femoral veins were filled with thrombotic masses. Chronic myocarditis and incipient pneumonia of the left lung.

*Critique.*—In this case, the embolus obstructed the artery practically completely. That the operation could be made before it was too late was due solely to the fact that the nurse judged the situation correctly, and without waiting for the surgeon's arrival, notified the operating-room attendants and had the patient transported there at once. This prompt action and the circumstance that the necessary instruments are always sterilized and ready for use made it possible to start the operation three or four minutes after the onset of the embolus. When the heart was laid bare after about three more minutes, it had practically ceased to beat, and only fibrillar contractions of the heart muscle could be seen. In my opinion, the patient would have been dead inside of eight minutes after the onset if the operation had not intervened. This case is thus an example of the occasional possibility of making the operation and saving the patient even in these sudden cases, if the hospital staff is sufficiently watchful and the surgeon immediately at hand.

As for the technic of operation, the greatest difficulty in my opinion is connected with the preservation of the pleura, at least in cases like the one under discussion, in which the operation had to be performed very quickly.

The pleura is exceedingly thin and easily injured. If it is to be kept intact, the ribs to be resected must first be carefully detached. This may take a good deal of time, and I consider that when the patient is already almost in agony, it is more important to carry out the operation rapidly, even at the risk of injuring the pleura, than to lose time in carefully freeing it. In all other cases it is necessary to avoid injuring the pleura.

In most cases of pulmonary embolism, only part of the thrombus has loosened and entered the heart. There is consequently a great risk of new thrombi detaching and forming new emboli to the lungs. This risk is increased when the patient, on regaining consciousness, is restless, breathes stertorously and moves about more than is permissible in a case of thrombosis. The patient's transportation from the operating room to his bed naturally also augments the risk. In the case described here, the patient undoubtedly died of a new embolus to the lung, which was found at the post-mortem to obstruct the entire right pulmonary artery and extended all the way to its ramification. As a very large embolus was removed at the operation from each branch, and since no other thrombotic masses could be found either with the forceps or by suction, I believe it is out of the question that the embolus found at autopsy could have been overlooked at the operation. The probe was introduced far into both the branches of the pulmonary artery without meeting any obstruction. It is hard to decide when this new embolus developed. It is possible that it had already detached at seven in the evening, three hours after operation, as the patient's breathing became more forced at that time and she complained of greater pain in the chest. However, these symptoms were relieved by the aspiration of air from the left pleura. The embolus may also have developed the following morning, at the time the patient suddenly became worse, but the fact that the embolus was found at the autopsy to be partially attached to the wall argues more or less against this assumption.

At the autopsy, both femoral veins were filled with thrombotic masses, proving that the danger of new emboli had not been removed. The chances of a final cure are naturally greater in cases in which the entire thrombus has detached at one time than in those in which there has been only partial detachment.

Of the eight cases published that survived the operation but died sooner or later after it, there were one or two in which large emboli were found in the pulmonary artery at the post-mortem examination. Thus, Meyer's second case died of a new embolus to the lung twenty-five days after removal of the first one, and in Nyström's third case, in which the patient died thirty hours after operation, the cause of death was probably also a new embolus. The risk of new emboli is obviously very great, and should be kept constantly in mind in the post-operative treatment of the patient and the estimation of the prognosis after the successful performance of Trendelenburg's operation.

# LIGATION OF THE ABDOMINAL AORTA FOR ANEURISM OF THE COMMON ILIAC ARTERY*

By G. Paul LaRoque, M.D.

of Richmond, Va.

from the department of surgery, medical college of virginia

The purpose of this report, in addition to putting on record a case of relief of symptoms of aneurism following ligation of the aorta, is to make inquiry concerning the cure of aneurisms in general, and especially those involving the iliacs, aorta, and subclavian arteries.

There are up to now on record eleven cases of complete and partial occlusion of the abdominal aorta which survived the operation long enough to note the effect upon the disease. The cases herein reported make a total of thirteen. Of these there were seven cases of complete occlusion by ligatures of silk or cotton, and six of incomplete occlusion, five by aluminum bands, one by cotton tape. Eleven cases have had necropsies within from thirty-nine days to twenty-five months following operation.

All thirteen cases are reported since 1900 by ten American surgeons, eight of whom are living. Their painstaking studies have contributed greatly to the knowledge of the subject.

Case No. 30-8024.—R. W., colored woman, age thirty years, admitted to St. Philip Hospital October 21, 1929, complaining of a "lump" in the lower abdomen, aching pain in the abdomen and right hip, radiating down the thigh. She had noticed these symptoms for only three weeks, but the pain was increasing, and the lump getting larger.

She was a healthy, well-nourished young woman, in whom there was a slightly tender tumor in the lower abdomen. The tumor was irregular in outline, immovably fixed, and palpable from the crest of the right ilium as far upward as within two fingerbreadths of the umbilicus and 2 or 3 inches to the left of the mid-line. There was a strong systolic expansile pulsation; no thrill could be felt, but a bruit could be heard.

Pulsation and blood-pressure in the right femoral and popliteal vessels was slightly weaker than in the left. The heart was not enlarged.

There were no signs of disease of the uterus, tubes or ovaries. The pulsating tumor was plainly felt by the finger in the vagina. X-ray of the pelvis and upper thighs showed no abnormal shadow, nor bone disease. Measurements at the groins showed the right thigh to be 24 inches, the left 22 inches in circumference. The blood Wassermann was strongly positive, the urine examination negative. *Diagnosis.*—Aneurism of the right common iliac artery.

After ten days in bed, operation was performed as follows:

Under spinal anæsthesia a long incision was made at the outer edge of the right rectus muscle, making special effort to preserve the integrity of the deep epigastric artery. With the peritoneal cavity open there was found a tumor the size of a partially flattened cocoanut, irregular in outline, located behind the peritonæum, densely adherent, fixed, extending from the right side of the bony pelvis nearly over to the sigmoid and exhibiting forcible and expansile pulsation. Coursing over the tumor could be seen the right ureter and many dilated veins. Neither of the iliac arteries could be identified.

* Read before the Southern Surgical Association, December, 1930.

Much effort was made, after incising the overlying peritoneum, to locate these vessels and after a time we found an artery the size of an adult finger located just to the left of the mid-line 2 inches or more above the promontory of the sacrum. Slightly above this point there was seen a small branch of the large artery (inferior mesenteric), going into the meso-sigmoid. When at this time, while an assistant had his fingers under the

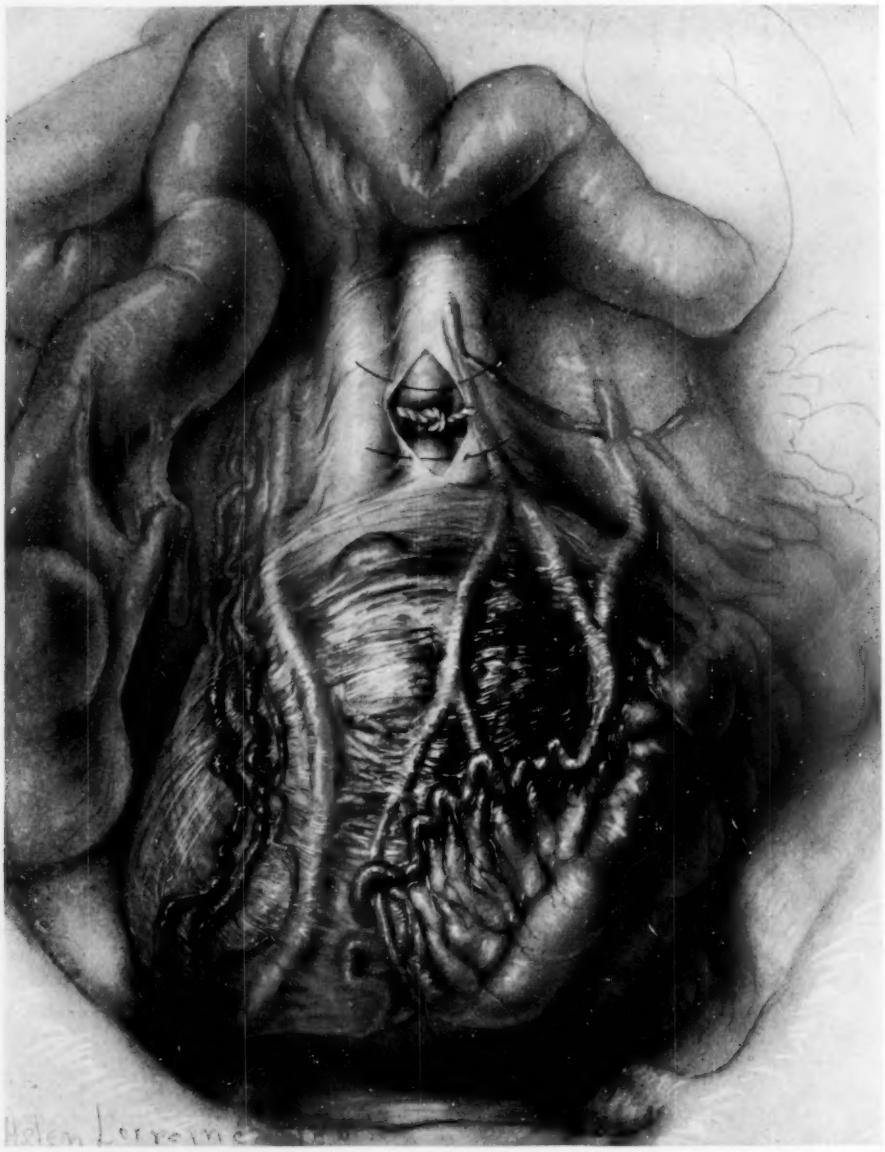

FIG. 1.—Ligation of the abdominal aorta for large aneurism of the common iliac artery.

sterile sheets one on each common femoral artery, we made pressure on the large artery (aorta), there occurred immediate cessation of pulsation of both femoral arteries and of the tumor, and the tumor diminished in size.

Another effort was made to identify the common iliac arteries, but these were so extensively covered by the tumor, which was densely adherent, that we were unable to

do so without unjustifiable risk of hæmorrhage. Upon making pressure sufficient for partial occlusion of the artery, there was noticed an intense thrill in the tumor, and when the artery was completely occluded the thrill and pulsation disappeared. The large vessel (aorta) was then gently separated from surrounding structures sufficiently to allow the passage of a large-size, curved hæmostat under the artery, for the purpose of drawing the ligature through. The artery was ligated with a coarse silk ligature, sufficiently tightly to obliterate completely the lumen of the artery, but not, we hoped, to crush its wall. After waiting about five minutes it looked as though the ligature might promptly cut through the vessel wall. We then placed over the first ligature in exactly the same position, a large ligature of twisted umbilical cord rope. This is about the size of a match stick and made of cotton. It was placed just tightly enough to obliterate the lumen of the vessel but not to crush the vessel wall. It was tied in a double straight knot, the ends cut close, the peritoneum lightly sutured over the ligature and vessels and the abdominal wound closed. In closing the abdominal wall we noted some venous bleeding and tied the deep epigastric vein. The artery was not injured nor ligated. The operation had consumed over two hours, the last hour of which necessitated gas and ether anæsthesia. The patient's condition was excellent.

The night following operation she suffered much pain in the right lower extremity, but by the next day this was relieved, and her convalescence was normal.

Four days following operation, we could feel a weak pulsation in the left femoral artery, but in no other vessel of either extremity.

At the end of two weeks the patient was out of bed, a week later walking about with moderate weakness. The tumor was greatly diminished in size, there was no pulsation, thrill or bruit. The woman was feeling well, begging to go home, and finally on the twentieth day following operation, was discharged.

Fourteen months after operation she works hard and says she is well. There is a faint pulse in the left femoral artery at the groin but in no other vessel of either extremity. She declines to return for further treatment. She fears we might want to operate upon her and she might die of the operation (I share with her this fear). We feel that if she lives long enough (escapes some intercurrent disease) she will die of aneurism or of bleeding at the site of ligation.

This is the sixth patient who survived the immediate effects of ligation of the abdominal aorta, and the fourth case that ever left the hospital alive, and did any kind of work.

The cases of Hamann[1] and of Matas[2] remained in the hospital in bed or a chair until they died, one six months, the other seventeen months after operation. Vaughan's case worked twenty-five months and died of large, leaking aneurism. Brooks' case lived three months, and showed at necropsy a large aneurism. Watts' case lived at home for more than three and a half years and died probably of rupture of the aneurism or the aorta.

The data secured through necropsy in the human cases coincide quite accurately with the data secured through experimental work in the laboratory.

Hamann's[1] case presents the only recorded opportunity to note the effect of ligation of the internal iliac artery and aorta in the human being in the absence of any disease of the vessels. At the first operation in April, 1916, the internal iliac artery was tied with chromic catgut. Following this, pulsation ceased for a few days, and in September, 1917, the abdominal aorta just above its bifurcation was tied tightly with heavy silk. Pulsation of the tumor ceased and never returned. On the third day feeble pulsation was felt in both femorals. In the report it was said there was no grossly obvious

gangrene, but on account of pain in the heel and an ulcer on the foot the leg was amputated. There was so little blood in the leg that the amputation stump did not heal. Concerning the collateral circulation, there was evidence of great increase of blood supply over the sacroiliac region around a bleeding bedsore. There were no signs of collateral vessels below the groin. After operation the patient was not improved in any way, and died at the end of six months. At necropsy the aorta at the point of ligation was three-sixteenths of an inch in diameter, and the lumen of the internal iliac was also partially restored.

In Keen's[5] case, reported in 1900, the aorta was completely occluded with four strands of floss silk. Eight days later the femoral pulse was palpable and in two days more pulsation in the aneurism had returned. Forty-eight days after operation necropsy showed the ligature cut through and there was hæmorrhage at the point of ligation and from the sac of the aneurism.*

Vaughan's[3] case (1920) was of distal ligation of the aorta at a point just below the inferior mesenteric artery; the lumen was completely obliterated at the time of the application of the ligatures. The aneurism appeared to be 1½ inches in diameter, and of a saccular type, arising from the left side of the aorta, about opposite the origin of the superior mesenteric artery. The pulse of the left foot was felt the day following operation but pulsation was never detected in the vessels of the right extremity. The man worked as a bricklayer and indulged in periodic alcoholic sprees until within two weeks before he died.

At necropsy, two years, one month and two days after the operation, the lumen of the aorta and the left common iliac artery had been restored, but the right common iliac was closed by either clot or connective tissue. The aneurism was 7 inches in length, by 6 inches wide (a very great increase in the size over what it appeared to be at the time of operation), the sac filled with firm, laminated clot. There was erosion of the bodies of the second, third and fourth lumbar vertebræ.

Reid[6] in April, 1921, for aneurism of the abdominal aorta just below the renal artery made partial occlusion with cotton tape just proximal to the aneurism; three months later (August 3), he made complete occlusion with cotton tape to the aorta just above the cœliac axis. Forty-one days later (September 14), necropsy showed both ligatures had cut through but without hæmorrhage; death was caused by rupture of the aneurism through the diaphragm into the chest. There was no anæmia of the viscera nor infarction of the vessels coming off below the ligature nor any evidence of circulatory disturbance in the lower extremity.

In Matas'[2] case (1925), the aneurism was of the terminal aorta, extending into both iliacs. The aorta was ligated just above the sac, with two completely occluding cotton-tape ligatures, one above the other. Pulsation and bruit in the sac and pulsation of both femoral arteries returned on the

* This is the case that caused surgeons to abandon the use of fine ligature material on the aorta.

ninth day. The right femoral pulse disappeared later, the left femoral pulse remained very feeble, no pulse in either foot ever reappeared. The woman had stormy times with many complications and was never as well after as before operation. Frank gangrene did not appear following the operation, but there was a contracture of the right leg, believed to be ischæmic in origin, which became worse following the operation.

Necropsy one year and five months after operation showed that the lumen of the aorta at the point of ligation had been restored to the size of the tip of a uterine probe. The aneurismal sac, though ruptured in several places, was filled with clot, the blood had circulated through the point of ligation into the left common iliac artery, but the right common iliac was obliterated in the walls of the sac.

The case of Brooks[10] was reported in 1926. The artery was ligated in two places, first with a piece of fascia lata and 1 centimetre below this a heavy braided silk ligature. Five weeks later the patient was discharged with pulsation present in the left femoral artery but not in the right femoral nor in the sac. Three months later he died of intestinal obstruction.

At necropsy the obliterated aneurismal sac, the size of a small orange, involved the terminal aorta and both common iliac arteries. The aorta at the site of the silk ligature was constricted. The silk ligature which had cut through lay wholly within the lumen of the vessel enmeshed in a thrombus. The fascia suture had completely disappeared and the aorta at this point was wide open. Both external iliac arteries were open, the right common iliac was partially open, the left common iliac artery and vein were obliterated in the wall of the aneurism. (The left (?) femoral pulse was palpable during life.)

An additional case not previously reported was kindly communicated to me by Dr. Stephen H. Watts,[7] who (1923) made partial obliteration by a tape ligature applied to the aorta just above the sac and below the superior mesenteric artery. The ligature was tightened until pulsation in the sac and femoral vessels was markedly diminished. The lumen of the artery was constricted to less than one-fourth inch in diameter. This patient lived more than three and a half years, with some improvement over her previous condition, and died of what Doctor Watts judged from the description given by her husband to have been rupture of the aneurism.

Of common iliac aneurism, Halsted[8] collected in 1912 all cases reported up to that time. A few are recorded since then. No case has been removed. Eleven cases in Halsted's reports and four or five since then have survived ligation of the common iliac artery. In only two cases were the patients observed for longer than four months, and in one of these, there was recurrence of the signs of aneurism at seven months. Halsted, in one case, applied the completely occluding band to the common iliac artery. Three and one-fourth years after operation, the patient wrote that he was relieved of pulsation and could not feel the tumor through his fat abdomen, but

the leg was cold and so weak and painful he could do little walking. After four or five years more of invalidism he died of undetermined cause.

Thompson[9] records a colorful description of his terrifying experience in dealing with left external iliac aneurism. Six months previously ligation of the left common iliac, followed nine days later by ligation of the right internal iliac, had been done without benefit. To read Thompson's report is discouraging to one who would attempt to do the Antyllus-Matas type of operation for aneurism in vessels beyond the control of a tourniquet.

Aneurism of the innominate artery has never been removed. The vessel has been ligated several times and in the few that survived the operation some temporary benefit but no cure has been attributed to it. The ligature may cut through and cause fatal hæmorrhage in a month.

Many cases of aneurism of the subclavian artery have been operated upon. Only two cases have been removed, both of them by Halsted, and both were cured. No case has been cured by ligation.

Experimental work, especially by Halsted and his pupils and by Matas and others, has brought forth much knowledge of vital importance.

In every case of constriction occlusion of a large artery, in continuity (at a single point without division of the artery), it is proven that regardless of the material employed the lumen of the vessel will be restored, usually within a few days, sometimes weeks. The wall of the vessel at the point of constriction becomes atrophied, new connective tissue forms, in place of the tissue at the point of strangulation, and the ligature cuts through into the lumen. Fine silk ligatures may cut through as early as two days with fatal hæmorrhage. Coarse ligatures are displaced much more slowly, their track becoming filled with new tissue, without the occurrence of secondary hæmorrhage.

Fine ligatures, partially occluding ligatures, and crushing ligatures may work through the wall of the artery before repair and the developing capsule of fibrous tissue are adequate to prevent hæmorrhage.

A metallic band being wider than the ligature, causes atrophy over a larger area of the wall of the vessel, requires a longer time to become thoroughly encased by connective tissue, and consequently entails more liability to secondary hæmorrhage.* The effects of consecutively placed ligatures close together need further investigation.

Catgut and fascia, tied about the vessel, may loosen, disintegrate and disappear irregularly and too quickly to be safe. This is shown at autopsy in Brooks' case.

The least infection at the site of ligation may be followed by hæmorrhage, extensive thrombosis and gangrene.

To ligate the artery in two separate places, and then cut the vessel between ligatures is the only certain way to prevent restoration of the lumen after

* In all cases in which bands had been applied to the human aorta (the last case in 1920), large hæmorrhage or small leakage occurred at the site of necrosis after three weeks. In one case an abscess was formed at the sinus in the vessel wall.

any method of constriction. The work of Brooks, Blalock and Johnson[10] has shown that in the case of the aorta, the immediate mortality and the incidence of gangrene are increased to a percentage making this procedure prohibitive for use in human beings.

For making total non-constrictive occlusion of the aorta in dogs, Reid[11] placed a strip of fascia made in the shape of a sphere into the vessel through a longitudinal incision in the wall of the aorta and sutured it in place by silk. Complete occlusion persisted for six months. It remains to be seen whether this method of dealing with the human aorta will be practical.

Experience and much experimental investigation during the past few years has led to the belief that veins, whether diseased or not should always be occluded whenever an artery is ligated. The investigations of Brooks[12] have contributed some disturbance to this belief. There is one comforting statement, however, in Brooks' conclusions. He would not ligate the companion vein of a large vessel at the time of operation upon the artery, but would reserve vein occlusion until the appearance of some evidence, such as pain, claudication and other signs of ischæmia, and then proceed to ligate the vein. Until it is positively shown that vein occlusion is harmful will it not be wiser to occlude the vein whenever for any purpose an artery must be ligated?

Halsted showed that following ligation of the common iliac gangrene from the operation *per se* is rare. Other factors are of great importance. The only case which was followed sufficiently long to determine the ultimate effects upon the nutrition of the limb is that performed by Halsted himself which after a year showed clinical evidence of ischæmia resulting in almost total crippling of the extremity. This operation was reported in 1912, before the ligation of companion veins was thought of as a useful procedure to be employed when for any purpose large arteries were to be ligated or excised.

For purposes of discussion certain concluding remarks are offered.

The diagnosis of aneurism is not always easy and may be difficult even after the tumor is exposed by operation. Hamann's patient had had one internal iliac artery ligated by one surgeon, and later the abdominal aorta ligated for what was believed when the tumor was exposed, to be aneurism of the common iliac artery, but shown at necropsy to be malignant neoplasm having no connection with the vessel. Diagnostic errors in considering aneurism of the aorta are extremely common—in both directions—and "conducive to clinical humility" (Osler).

In cases of Matas and of Brooks, in which the aneurisms were thought to be of the common iliac, both were shown at necropsy to be of the terminal aorta, and involved the iliacs secondarily. If my case should prove likewise (and such might well be the case), all reported cases of survival after ligation of the aorta for common iliac aneurism will have been cases of error in diagnosis.

Even Halsted mistook for aneurism a case of tortuous subclavian artery; and in another the aneurism believed to be of the innominate, was of the arch of the aorta.

What should be the criteria by which we judge aneurism to be cured? Shall we be deluded into the belief that aneurism has been cured merely because the patient is relieved of pain and pulsation and the size of the tumor is diminished? The dramatic effects of ligation upon the agonizing pain and tumultuous pulsation of the large aneurism might be followed by gratitude so deep as to cause the patient to magnify the amount of relief and minimize the intensity of the still existing symptoms. The surgeon also may be so thrilled with the joy of being able to accomplish the dramatic feat of ligating a large artery and seeing his patient alive the next day that even he may magnify in his own mind the beneficial effects of his accomplishment. After weeks or months have passed, however, coincidentally with the subsidence of the patient's gratitude and the surgeon's initial satisfaction, both individuals may notice symptoms due to return of circulating blood in the aneurism and are then mentally competent to realize the truth concerning the amount of relief secured by the operation.

Sacculated aneurism is a definite gross pathological lesion at the point of the degeneration of an artery and is characterized by progressive increase of size and development of pressure effects upon surrounding structures. The symptoms of aneurism, pain and pulsation, may be temporarily relieved by many remedies, and are subject to spontaneous remissions and exacerbations of intensity. Cases of aneurism have been found at necropsy and even during life in which symptoms were not present or at least not conspicuous. It is an interesting observation that frequently the history of pain and pulsating tumor is of short duration (days or weeks), and there may be found at operation (or necropsy) a sac obviously of much more ancient duration (months). In these cases there are signs of small hole rupture, and leakage of the sac, with secondary sacs and hæmatomata. Might not the age of these secondary formations coincide with the increased pain and size of the tumor?

Can ligation of the artery at any point be expected ever to cure aneurism, or have more than a temporary effect in prevention of further symptoms? Superficial reading of experimental observations, clinical reports and necropsy findings will promptly dispel any such belief. Ligation is essential as a preliminary step before excision or obliteration in aneurisms above the domain of the tourniquet and may be more useful than non-surgical measures in certain cases in which extirpation is not safe, but its function is palliative of symptoms, not curative of the disease. May it not be that the reason gangrene does not more often follow ligation of large arteries is the same reason that the aneurism returns to activity, *i.e.*, the ligated vessel promptly becomes patulous, the blood continues to flow through the same vessels into the aneurism and into the extremity?

The rational and only curative treatment of arterial aneurism is by obliteration or excision of the sac with or without preservation of the artery or restoration of its lumen.

This, since the monumental work of Matas, has been practical in the hands of good surgeons in most cases of aneurism in which the control of the circulation is within the domain of the tourniquet (the extremities).

For aneurisms proximal to the external iliac and terminal portion of the subclavian arteries (without the domain of the tourniquet), no one has yet reported a case cured by the Matas procedure.

Halsted, after ligating from without the sac all vessels communicating with the aneurism, removed the aneurism in three cases; in one from the external iliac artery and in two from the first portion of the left subclavian artery. These are the only cases on record of complete cure of aneurism of any artery between the inner third of the clavicle and Poupart's ligament. No one has reported extirpation of a case of aneurism of the internal iliac, common iliac, aorta, or innominate artery.

This procedure (the Halsted operation) may be performed in one or two stages. It may not be applicable to the aorta above its visceral branches because of the fact that these are located so closely together that they are of necessity involved in all aneurisms of recognizable size and must not be ligated.

The common iliac artery is so short (from 1½ to 3½ inches), that excision of a large aneurism of this vessel might entail great danger of having to divide the external and internal iliacs, or the terminal aorta itself.

For these and for all anerisms of the abdominal aorta does not Reid's successful obturation of the aorta in dogs by a fascial plug sutured in the lumen give hope of successful palliative treatment?

For common iliac aneurism of smaller size, and for all subclavian aneurisms, Halsted's operation can be made safe; and the surgery of arterial aneurism lifted out of the stage of case reports into the stage of organized knowledge.

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# THE RELATION OF THE WELCH BACILLUS TO APPENDICITIS AND ITS COMPLICATIONS*

By John E. Jennings, M.D.
of Brooklyn, New York

Ten years ago we began a study of the relation of Welch bacillus infection to gangrenous appendicitis and peritonitis and of the possible clinical value of the antitoxin available at that time. In 1923 and again in 1925 we reported our results up to that time which appeared to indicate some value in the use of the serum and suggested the possibility of its usefulness in intestinal obstruction and as a prophylactic in perforating wounds of the bowel and in operations on the intestinal tract.

It may not be out of place to summarize briefly the contents of these previous papers before discussing subsequent experience in this field.

It seemed evident that in gangrenous appendicitis and peritonitis we have to do with a fæcal infection due in part, at least, to the activity of the Gram-positive anaërobes that normally infest the gut and whose presence in war wounds was so regularly associated with gas gangrene. We had seen occasionally infection of the abdominal wall after operation for appendicitis in which gas gangrene had supervened and a few similar cases associated with retroperitoneal emphysematous œdema. These cases were unusual. They were all highly toxic in their course and all were fatal. In a few cases we had been led to suspect the presence of the bacillus aërogenes capsulatus of Welch and to verify its presence by cultivation and animal inoculation. We considered, at that time, however, that these were rather rare infections. We had no therapeutic measures with which to combat the disease and the difficulties of routine anaërobic bacteriological study hampered further investigation. This was before the war.

There are several things in the picture presented by a case of gas gangrene of the extremities in his last hours that singularly resemble that of one dying of peritonitis. The low temperature, the rapid, feeble pulse, the dusky flush and cyanosis, the dyspnœa, the dilated pupil, the euphoria. The similarity is more than suggestive.

When we returned to civil practice we found one American antitoxin serum—a mixed antitoxin for tetanus and perfringens—available, and its use in a series of gas gangrene infections seeming to establish its value, it appeared worth trying in appendicular peritonitis.

I shall not repeat here the résumé of the literature made in 1923. That dealing with the Welch bacillus is massive but discussion of the activity of that organism in surgical conditions within the abdomen is not very rich. I would, however, refer once more to the monograph of Heyde of Friedrich's

* Read before the New York Surgical Society, November 12, 1930.

clinic in Marburg, published in 1911 and devoted to a study of the anaërobes in appendicitis. I know of but one subsequent study of equal analytic scope, to which I shall refer later. He attempted to answer the following questions:

1.—What anaërobic types are found?
2.—How often do they occur?
3.—Do particular forms predominate at different stages of appendicitis?

His investigations were painstaking and time consuming. He found that from one to two months were necessary for a complete study of the isolated strains from any given case. His findings are not without interest even now. He found the greatest obstacle to his study in the presence of the B. coli which by its rapid growth obscured and distorted the true bacteriologic conditions present. He did not believe that within the animal body the B. coli is able to split up proteid with the formation of putrid products but thought that this supposition, which has been so widely held, was due to overlooking the existence of anaërobes which were present at the same time. Bacillus coli showed none of that ability to form foul-smelling products credited it by so many authors. He listed seventeen varieties of anaërobes isolated, concluded that anaërobic bacteria were present in one hundred out of one hundred and two cases studied and that they were present in greater profusion than aërobes in all stages of appendicitis and peritonitis and attributed to them the direct causation of inflammation, of gangrene and of toxæmia. He found that the perfringens group—B. Welchi—outstripped all others in rapidity of growth.

Simonds, however, in his classical monograph, "Studies on B. Welchii, with Special Reference to Classification and to Its Relation to Diarrhœa," noted, in 1915, that the relation of anaërobes in general and of B. Welchii in particular to appendicitis was still unsettled. There are, however, some more recent contributions that deserve notice.

Gas bacillus infection of the abdominal wall has been noted and reported by Beer, Winter, Russell, Ochsner, Dayton and others. These spreading gangrenous processes are rare but a milder and comparatively harmless involvement of the fascia and subcutaneous tissue is present in many drained cases. The Welch bacillus can be regularly recovered from such cases by proper anaërobic methods.

Our problem was to study the occurrence of the Welch bacillus from the lumen of the appendix in cases of appendicitis and attempt to evaluate the use of an antitoxin in cases in which we found it in the peritoneal fluid. This we did as follows: We made

1. Anaërobic cultures of the contents of appendices removed at operation.
2.—Anaërobic cultures of specimens of tissue taken from the wall without invasion of the lumen of appendices removed at operation.
3.—Anaërobic cultures of the fluid removed from cases of peritonitis secondary to gangrenous appendicitis.

4.—Anaërobic cultures of the blood in cases of proven B. Welchii peritonitis.

5.—Post-mortem studies in cases of death due to peritonitis and appendicitis.

6.—Clinical studies of the value of antitoxin in cases proved by culture to be infections with B. Welchii.

We found that cultures made from the contents of the lumen of appendices removed at operation showed the presence of B. Welchii in 90 per cent. of the cases.

In seven cases in which the appendix was acutely inflamed, thickened and œdematous but with no gross perforation, cultures made of portions aseptically removed in the operating room and so cut as to remove the peritoneal and muscular coats of the organ without invading its lumen also showed the presence of Bacillus Welchii.

In sixteen cases, localized pus collections with gangrene showed B. Welchii and in forty cases in which culture was made from free fluid in the pelvis or general peritoneal cavity, B. Welchii was found ten times.

The results of blood culture were, for the most part, negative. The studies of the blood made in cases of gas gangrene during the war showed that blood culture is negative at the beginning of gangrene. In cases fully developed Lardenois and Baumel found seven positive cases in forty-eight cultures. Weinberg and Segine found four positive cultures before death in twenty cases of hæmoculture. Delbet and Fiessinger found two positive in seven blood cultures made in the agonal period. It is evidently the general opinion that the passage of organisms into the blood occurs just before or after death as the antitryptic indexes alkalinity are lowered.

It seemed to us evident that the Welch bacillus was present in the lumen of most appendices and is frequently found outside of the gut in an actively growing form in appendicular abscess and in localized peritonitis and in a rather large number of cases in free peritoneal exudate, that in most cases its activity is cut short by operation with removal of the appendix but that this is not always the case and it is apparently an active factor, if not the most active factor, in the production of a fatal disease.

In the beginning of the work we were handicapped by the fact that culture made at the time of operation required from twelve to twenty-four hours for an available report. We found, however, that by making injections of the suspected material in the liver of the living guinea pig, killing the animal at the end of three minutes after injection, and placing the animal in the incubator, study of the liver, at the end of two hours, was an adequate clinical test. Smears were taken from the bloody peritoneal fluid, the liver itself and from the heart's blood. In positive cases the organism could be seen easily. According to our records there were 97 per cent. positive findings in animals after two hours compared with the positive anaërobic milk cultures. We felt, at that time, the desirability of an assured bacteriological diagnosis before ad-

ministering the antitoxin. It was, and is, expensive. The reactions when given by the intravenous route were quite severe and sometimes alarming and we were feeling our way. After using this routine for about four years we thought we could recognize, in the clinical appearance of the peritoneal exudate and by the examination of smears made at the table, the presence of the Welch bacillus sufficiently accurately for our purpose and described the cases thus.

The cases of diffuse peritonitis in which the anaërobes are present in numbers show a more or less typical clinical picture. The temperature is not, as a rule, much elevated, the pulse rate out of ratio, they are cyanotic and the pupil is dilated, a dusky flush may be present. At section the fluid may be foul or not, a dark colored or coffee-ground fluid is sometimes seen. One may find, in the region of the base of the cæcum, an emphysematous retroperitoneal cellulitis spreading and sometimes extending to the anterior abdominal wall. The progress of such a case may be quite favorable for from twenty-four to forty-eight hours when with comparatively little distention and little or no regurgitant vomiting the pulse becomes rapid and thready, cyanosis becomes more profound, the skin grows clammy, respiration more and more rapid and death occurs.

We then gave up the guinea-pig culture method which we felt we could do without but did not begin routine prophylactic injection until several cases of gangrene of the appendix with but slight peritoneal involvement apparent at the time of operation unexpectedly developed peritonitis on the third or fourth day, which went on to a fatal termination with the proven presence of Welch bacillus, missed by smears at the table and unsuspected. We had been considering the path of infection from the lumen of the appendix into and through its wall to the peritoneal cavity eventually, terminally, or post-mortem to the blood-stream. It had not occurred to us that after the removal of the appendix any large infected area of bowel wall might remain in the picture.

The following case was enlightening:

Case 729.22, a child of five years, showed a general diffuse peritonitis of seventy-three hours' duration with cyanosis, distension, feeble and thready pulse. At operation, free turbid fluid in the peritoneal cavity; a leaking abscess. Appendix showed terminal gangrene with a small perforation. One hundred cubic centimetres of perfringens antitoxin were given on the operating table; six hours after operation the radial pulse was imperceptible and more serum was given, 150 cubic centimetres in the vein, 200 cubic centimetres in the axilla, following which the little patient rallied a few hours; later another collapse was controlled by more serum. Altogether 970 cubic centimetres of serum were given, most of it intravenously. The patient rallied after each administration. Seven days after operation lobar pneumonia developed. In the meantime the abdominal distension continued extreme and never yielded to treatment. On the eleventh day the pulse became imperceptible, the skin cold and clammy, and she died. The cultures were positive for B. Welchii. At autopsy the last 12 inches of ileum were found gangrenous and adherent to the pelvic wall. The intestine above it was greatly distended—a complete obstruction. The general peritonitis had subsided but the local gangrenous process in the terminal ileum had gone on.

It was apparent, in this case, that the antitoxin had been sufficiently active to control the toxæmia of the peritoneal infection but that the local gangrenous process in the terminal ileum had produced an intestinal obstruction which proved fatal. We then observed particularly the condition of the terminal ileum in autopsies made on cases dying of gangrenous peritonitis and found in most of them a much thickened wall with diffuse hæmorrhagic ulceration and beginning gangrene. It was evident that this portion of the bowel was paralyzed by an inflammation approaching gangrene and would act at once as a passively obstructed segment and a source of absorption of toxic matter. This suggested inspection of the terminal ileum in cases in which this seemed safe at operation and we were interested to find, in practically every case, a greater or less degree, in many cases marked, of œdema, thickening and loss of peristatic excitability.

It seems probable that many cases of so-called acute appendicitis are in reality acute inflammations of the terminal ileum and cæcum in which the appendix, on account of its terminal blood supply, offers less resistance than the other lymphoid structures. How important a factor this ileo-typhilitis is in the mortality of appendicitis our autopsy material does not allow us to infer, but it would seem to be not entirely negligible.

Williams made a therapeutic test of the value of Bacillus Welchii antitoxin in cases of general peritonitis and intestinal obstruction at St. Thomas' Hospital. Antitoxin was given to eighteen of the most severely ill of a series of 256 consecutive cases of appendicitis with a reduction of mortality from 6.3 per cent. in a parallel series to 1.17 per cent. His conclusions were: In cases of peritonitis with paralytic obstruction there was a marked clinical improvement as the result of administration of Bacillus Welchii antitoxin. In cases of organic obstruction similar effects were obtained but in individual cases it was as a rule impossible to differentiate between the effects of the serum and the effect of successful operative relief of obstruction.

Williams, however, reported no bacteriologic studies of appendices or of peritoneal exudate and his work was based on the assumption that death, in septic peritonitis, is the result of absorption from the paralyzed small intestine of the toxins of the Welch bacillus. His use of the antitoxin was directed to the neutralization of this poison. He does not discuss any intoxication save that from within the gut.

Copher, Stone and Hildreth made an experimental study of the value of antitoxin in intestinal obstruction and peritonitis in dogs. They report that life was prolonged in the experimental series of dogs having acute, general peritonitis and acute intestinal obstruction by the use of the B. Welchii antitoxin.

Bower and Clark reported the use of B. Welchii antitoxin at the Samaritan Hospital in Philadelphia. In eleven cases of acute diffuse suppurative peritonitis, nine cases of acute intestinal obstruction and five cases of acute suppurative cholecystitis, they were convinced of its value.

Morton and Stabins studied experimentally the effect of B. Welchii antitoxin in high intestinal obstruction in dogs. They conclude that their results support the contention that the toxin of B. Welchii has a bearing on the toxæmia of intestinal obstruction. In a large number of cases the antitoxin of the B. Welchii seems to be potent in combination with surgical procedures to relieve the obstruction in bringing about the recovery of dogs with obstruction—control dogs do not recover under similar circumstances.

With regard to the use of Welch antitoxin in intestinal obstruction we have been disappointed. In several cases, remarkable but relief improvement has followed the administration of larger doses; in a few its use has apparently contributed to recovery. In most of the cases in which it has been used its value did not appear. It is in France, however, that the most advanced work has been done.

Michel credits to Paul Delbet at the suggestion of Weinberg the first employment of anti-gangrene serum in appendicitis. He reported thirteen cases at the twenty-ninth Congrès Français de Chirurgie with twelve recoveries.

Bérard and Cotte later reported nineteen cases with sixteen recoveries.

Bouchez in his Thèse de Paris, 1920, discussed the use of anti-gangrene serum in infections of intestinal origin with successful animal experimentation.

Michel and his pupil Rakovatz report that serotherapy and surgery show a mortality of 15 per cent. in cases which he charges with an expected mortality of 70 per cent. treated by surgery alone.

Weinberg, Prévôt, Davesne and Renard present studies on the bacteriology and the sero-therapy of acute appendicitis—a most complete and satisfying investigation which should be read entire.

They conclude that work on the bacteriology of appendicitis may be divided into three epochs. In the first, the isolation of aërobic organisms; in the second, beginning with Vuillon and his collaborators the primordial rôle in the evolution of that infection was attributed to the anaërobes neglecting or relegating to a second place the aërobic organisms. In the third, in which they now struggle, the ideal is to assign to each germ in the often very complex flora of a given case the part played by it in the symbiosis. They describe many combinations but consider that the primordial rôle in appendicitis belongs to B. coli and B. perfringens. They advise the use of a mixed serum to which anti-coli serum is added. They are better provided with antigangrene sera than we are but it is evident that they consider the perfringens antitoxin as the most valuable constituent of them all. They advise, as does Michel, the delay of surgical intervention in advanced cases until the administration of antitoxin has had time to take effect. They go so far as to suggest its use in the medical treatment of early cases.

*Antitoxin.*—In the beginning of our work we gave antitoxin intravenously with severe reactions in many cases in spite of subcutaneous injection of small amounts of serum given an hour before for desensitization. Increasing subcutaneous doses were then used over several hours for the same purpose. A measure of success followed this procedure but reactions, some quite severe, continued to occur. A few were alarming and for the last five or six years we have found just as satisfactory results with the subcutaneous method. We now adopt the following routine:

In all cases in which gangrenous change is apparent in the appendix 100 cubic centimetres of antitoxin is added to 1000 cubic centimetres of normal salt solution and given by hypodermoclysis. Anaërobic and aërobic cultures are made from the peritoneal exudate in the immediate neighborhood and from the fluid found in the pelvis, and further administration of antitoxin is guided by the result of culture and by the course of the case. If the organism is present in the peritoneal fluid and if evidence of peritonitis appears, and especially if the patient shows a rapid pulse with cyanosis, repeated and larger doses are administered—200 cubic centimetres daily for two or three days. The immediate effect of the antitoxin is more dramatic when given by the vein, but its action, while slower, is more prolonged by

the subcutaneous method, with no reactions. From five to ten days after injection serum rashes regularly appear.

The actual value of such a method of treatment can be determined only by an extended use in routine by a number of men in several institutions. I have used it with some freedom in more than one but have thought it best to present fifty cases from one hospital and to compare this series with the mortality of a larger group.

In a series of 450 cases of acute appendicitis cared for by several operators at the Brooklyn Hospital in the last five years, 297 were suppurative or catarrhal; of these two died, a mortality of .67 per cent. One hundred fifty-three cases were gangrenous with more or less peritoneal involvement. Of these twenty-five died—a mortality of 16 per cent. Of this group ninety-eight were cases of localized gangrene or abscess, of which thirteen died, thirty-eight were classed as spreading peritonitis with six deaths, and seventeen as generalized peritonitis with six deaths.

In the group treated with antitoxin there were no simple or suppurative cases. The serum was used only in cases of gangrene and its sequelæ, often late, often sparingly.

There were, however, ten cases of localized gangrene and abscess with one death, fifteen cases of spreading peritonitis with three deaths and twenty-five cases of general peritonitis with six deaths.

In the first series, the deaths from general peritonitis showed a 35 per cent. mortality; in the second (with antitoxin), a rate of 24 per cent.

It will require a much larger series and a more consistent use of antitoxin early, before a true estimate of its value can be made. At present it is our feeling that it should be tried in all cases presenting gangrenous change in the appendix at operation and in cases showing evidence of any peritoneal involvement at that time, and that its use should be extended until the case is out of danger or beyond help. A more critical and complete bacteriological study of appendicitis and of intestinal sepsis and a clinical evaluation of its results are most evidently needed and a larger *materia medica* of antitoxin sera would seem from the French experience to be needed. It is to be hoped that both these needs may be supplied.

ILLUSTRATIVE CASES

Case I.—W. D., Jr., a boy of ten years, who had been sick for a week, was admitted with a rigid and somewhat distended abdomen with a tender mass in the right iliac fossa. Cyanotic, dilated pupils. Temperature 102°, pulse 140, respirations 40. Operation showed a generalized purulent peritonitis, a gangrenous appendix hanging over the pelvic brim, which contained foul, brown fluid. Appendectomy and drainage. Antitoxin immediately—100 cubic centimetres by clysis, repeated once on the second day. Pulse reached normal on the third day, temperature, on the sixth, after which a good recovery. Culture—B. Welchii and colon.

Case II.—D. J., a child of eight years, admitted after two weeks of fever with a mass in the right lower quadrant size of a grapefruit. Temperature 104°, pulse 140, respirations 40. Operation showed an appendicular abscess which contained about 3 ounces of foul pus. There was some spreading peritonitis present. Antitoxin, 100

cubic centimetres, was given on the day before operation by clysis and this was repeated two days later. The cyanosis did not disappear until after the second injection. A moderately stormy convalescence was established by the seventh day.

Note the early subcutaneous use of serum.

CASE III.—S. S., aged forty-five years, admitted forty-eight hours after the beginning of her third attack. Her pain began in the right lower quadrant which persisted in spite of castor oil and enemas, and at the time of admission to the hospital was general. She vomited thirty-eight hours after the beginning of the attack. Her abdomen was moderately distended and generally tender, the right side more than the left. Her entire right side was markedly rigid. There was moderate rigidity on the left side, more marked below. Her temperature was 102°, her pulse 120, her respiration 40; 17,000 leucocytes, 8,070 polymorphonuclears. She was somewhat cyanotic. She was operated on immediately and a gangrenous appendicitis with general peritonitis, foul, free pus, creamy brown, foul, surrounded the purple and inflamed coils of small intestines. The pelvis was full of foul pus; there was more pus in the right kidney fossa.

An appendectomy was performed and a drain inserted to the pelvis and to the appendix stump. She received 100 cubic centimetres of perfringens antitoxin intravenously on the second day and another 100 cubic centimetres by clysis on the third. Her convalescence was stormy with repeated vomiting, approaching fæcal in character, a low temperature and a high pulse rate, which reached ninety on the seventh day, after which she made an uninterrupted recovery. Culture of the peritoneal fluid gave B. Welchii in pure culture.

CASE IV.—D. P., admitted with a history of vomiting and abdominal pain for twelve days; the pain in the main, suprapubic. Temperature 100°, pulse 100, respirations 20; leucocytes 14,400, polymorphonuclears 82 per cent. A large, rounded mid-line mass between the navel and the pubes. Operation showed the whole lower abdomen filled by an inflammatory mass; finger dissection, after walling off, opened a cavity containing about a quart of foul-smelling, thin pus. A counter incision and drain in left inguinal region and rubber tube drains to the cavity in the pelvis. No attempt to find the appendix. A fæcal concretion was found in the cavity. He did not receive any antitoxin until the first day after operation when he was given 500 cubic centimetres in the vein. This was repeated in the next two days until he had 1,000 cubic centimetres in all. A temporary improvement was not maintained. An overwhelming intoxication carried him off by death on the fifth day.

CASE V.—F. R., a girl aged sixteen years. Pain in the epigastrium two days before admission; vomited repeatedly the next day and pain shifted to the right lower quadrant. On admission, marked right-sided rigidity, most pronounced below. Rectal examination revealed a mass in the right upper pelvis, very tender to touch. Temperature 100.2°, pulse 160, respirations 40; leucocytes 23,600, 90 polymorphonuclears.

At operation four ounces of opaque yellow fluid escaped. The omentum fastened to the base of the cæcum from which an appendix, 3½ inches long, ran straight down from the brim to the bottom of the pelvis. The distal half was gangrenous and perforated with free fæcal matter surrounding it. The appendix was removed and a ⅝-inch tube with raffia to the bottom of the pelvis, a smaller soft tube to the base of the cæcum.

One hundred cubic centimetres B. Welchii antitoxin was given eighteen hours after operation and repeated every twelve hours until 600 cubic centimetres had been given. The pulse rate fell to 100 on the second day and remained there. The temperature reached normal on the eleventh day. She suffered from marked distention and vomited fæcaloid material on the third and fourth days. Lavage was not needed after the fifth and she made an uncomplicated recovery.

Culture B. Welchii and colon bacillus.

The fæcal peritonitis, the immediate response of the pulse rate to antitoxin, the continued fever and peritonitis, the critical period of the fourth and fifth days and the associated colon infection are noted.

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# POST-OPERATIVE PAROTITIS*

By Paul H. Charlton, M.D.

of Columbus, Ohio

From the Department of Surgery of the Ohio State University

Although this condition was first described by Munde in 1878 following ovariotomy, Paget as early as 1886 reported 101 cases of secondary parotitis, one-half (fifty-one) of which took place after operation upon the abdomen, which included gastrotomy, enterostomy, as well as herniotomy, colostomy, abdominal and umbilical tumors and penetrating wounds of the abdomen. The other 50 per cent. occurred after operations upon the female genitalia. He declared that the peritoneum, genital organs and parotids were indirectly and reflexly related (bear in mind that abdominal surgery then chiefly dealt with the pelvic organs, particularly with ovariotomy). In 1889 Hanau stated that parotitis occurred secondary to infection of Stenson's duct by mouth organisms. However, the two theories, namely that metastatic foci develop in the gland only from sepsis on the one hand and that it is a local extension of infection from the mouth up Stenson's duct on the other, have continued until today, the more general consensus on opinion favoring the later view. Hanau and Pilliet believe that the organisms go up the duct and in their pathologic specimens demonstrated that the inflammation began around the ducts and spread outward into the perilobular tissue, whereas, they argued, should the etiology be embolic the inflammation should at first appear as a perivascular process. The outer one-third of the duct contains the same organisms as found in the mouth.

A close analogy is suggested between infections of the salivary glands and other large glands which also empty into mucus-lined cavities. The cases usually fall into two broad groups, one in which an acute inflammation of the gland is the first noticed and predominant symptom, and the other presenting primarily recurrent symptoms of duct obstruction. Added to the obstruction there may be any grade of inflammation of the gland and duct. The obstructing agent might be simply the swelling and thickening of the mucosa or a plug of mucus lodged at the meatus or some inflammatory constriction or a stone formed anywhere in the duct. While it is now generally accepted that at least the great majority of pyogenic inflammations of the parotid gland are due to an ascending infection there is evidence to warrant the belief that a blood-born infection is an occasional cause of acute suppurative parotitis. It is also likely that infection may be born by the lymphatic channels.

In addition to the presence of oral infection the most commonly mentioned predisposing factor is dryness of the mouth following operation, due to the

* Read before the Columbus Surgical Society, October 26, 1928.

practice of withholding fluids as well as the temporary hyposecretion following hypersecretion during and after narcosis. In this connection it is interesting to note the report of the study of 1,000 cases of gastric ulcer treated medically and not surgically. In 470 cases treated with oral starvation there were twenty-one cases of parotitis, an incidence of 4.5 per cent., while in 530 cases allowed something by mouth there were only two cases of parotitis, an incidence of but 0.4 per cent. It is apparent from these figures that acute suppurative parotitis occurs ten and one-half times more frequently in such cases of gastric ulcer than in cases allowed fluids by mouth. In this series mouth washes did not seem to have any influence upon its occurrence. Of course the question naturally arises that if dryness of the mouth is an exciting factor why do not the sublingual and submaxillary glands become involved, although they very rarely do. This is explained by Lynn on the basis that the parotid is essentially a serous gland while the submaxillary and the sublingual are of the mucous variety. Stuart Low has demonstrated a definite inhibitory effect of mucin on bacterial growth. Likewise the parotid contains lymph nodes while the other glands do not, thus favoring the extension of inflammatory processes. On the other hand Buscarlet and Kaiser abroad and Jennings and Fisher in this country hold the view that secondary pyogenic parotitis originates as a result of metastatic foci from purulent exudate elsewhere in the body or as a part of a general pyæmia. As a rule the evidence of positive blood culture is lacking. The supporters of the hæmatogenous theory believe that the infected emboli find favorable soil in the parotid gland as the masseter muscle interferes with the blood supply to the gland and congestion often develops. Against this theory is the fact that it may occur in cases where the operative wound healed by primary intention with an entirely aseptic course. I believe that it has been clearly demonstrated that the type of anæsthetic or the preliminary hypodermic have no bearing.

Traumatism at the time of operation, by pressure upon the angle of the jaw and the gland has been mentioned by some authors but I believe that the occurrence is as great in cases operated under other types of anæsthetics than general (local and spinal) or in cases where particular attention has been paid to this as a causative factor.

*Occurrence.*—The condition occurs most frequently in adults, especially after the third decade of life. It is more common in the female; this I believe is due to the fact that the majority of abdominal operations are upon the female. More cases have been noted to occur from November to April when respiratory infections are more prevalent; 20 to 33 per cent. are bilateral. Most cases follow severely infected conditions, appendicitis, peritonitis, perforating gastric ulcer, and so forth. In fact, next to ovarian cyst, perforating gastric ulcer is said to be the most frequent operative condition which is followed by parotitis. Collins reports 6,100 operative cases with eight cases of parotitis, 0.13 per cent. (one of these occurred awaiting operation). All these cases were abdominal operations. This series now includes

thirteen cases occurring in 2,716 major operations (0.47 per cent.). There were four deaths and nine recoveries, and two cases were not operated upon.

*Classification.*—Deaver prefers to classify these cases as follows: 1, Metastatic, in pyæmic conditions; 2, ascending, *via* the ducts; 3, traumatic. I believe that a better classification and one that is more helpful in indicating the treatment is as follows: 1, Simple acute; 2, acute suppurative; 3, gangrenous.

*Bacteriology.*—The most common infecting organism is the staphylococcus. The other organisms that are found are the pneumococcus, streptococcus, and bacillus coli in the order named. Hellendale reports one case of post-operative gonorrhœal parotitis but he does not think that the demonstration of gonococcus pus from the parotid is any final proof of the hæmatogenous origin of the infection.

*Signs and Symptoms.*—The condition usually appears in two to ten days following operation, although Fowler reports one case eighteen days post-operative. There may be no great change in the patient's general condition while on the other hand there is usually a sharp rise in the patient's temperature, even to 104° F. or 105° F., with a corresponding increase in the pulse rate. The attack is ushered in, as a rule, by severe pain in the region of the angle of the jaw. The pain is severe owing to the abundant strong fibrous septa throughout the gland which is of the racemous type, thereby permitting very little tension. The location and relation of the gland is also a factor in the production of pain. Swelling of the glenoid portion of the gland produces pain in the ear and in the temporo-maxillary articulation. Swelling of the carotid and pterygoid lobes causes pain and fulness in the throat. Opening the jaw decreases the space between the jaw and the external auditory canal and mastoid, thereby pinching the gland. Dyspnœa and dysphagia may be evident due to pressure inward of the swelling. While extension from one lobe to another is slow due to the dense septa the whole gland is often involved in the process.

*Clinical Course.*—This may be mild with little fever and slight discomfort or moderate pain and slight swelling limited to the parotid region. On the other hand the conditions may be extremely severe from the first with all the clinical symptoms and laboratory findings of a severe infection, including great pain in the gland, chills, high fever and marked swelling, first in the gland itself and then later a rapidly spreading œdema of the neck, head, and face. This œdema may close the eyes and may involve the neck down to the clavicle. It may extend inward into the pharynx embarrassing the air passages. Delirium may intervene and in children there may be convulsions. The process may rupture into the external auditory canal. Seventh nerve involvement is rare. The process may rapidly become gangrenous.

*Diagnosis.*—This is based upon the history of a recent injury or operation, discomfort and pain in the neck, swelling and tenderness of the gland and constitutional and laboratory findings of a pyogenic infection. If the operative field is nearby a differential diagnosis of a lymphadenitis or cellulitis must be made. The constitutional symptoms depend upon the severity of

the infection and the reactionary power of the patient. The temperature may be 103° F. to 105° F. and the pulse 110 to 130. In cases of low virulence the temperature may only reach 99° to 99.5° F. The leucocyte count varies from 9,000 to 25,000. In seeking parotid tenderness and swelling bear in mind the gland runs forward below the lower border of the zygoma and extends backward behind the ramus of the jaw below the lobe of the ear.

*Prognosis.*—Every post-operative parotitis is a potential lethal factor until it proves itself benign, and to await spontaneous evolution jeopardizes life. The death rate is 33-33.5 per cent. in those cases requiring incision and as high as 42.8 per cent. in all cases. This figure may be inaccurate by the fact that the original condition for which operation is performed is often a definite factor in the mortality. In the cases in which the parotid infection was but one evidence of a terminal condition it is an essentially fatal malady and not favorably influenced by any form of treatment.

*Complications.*—These need only be mentioned and may consist in thrombosis, phlebitis, or ulceration of large vessels with hæmorrhage necessitating the ligation of the external carotid. Sinus thrombosis, meningitis, retropharnygeal abscess and abscess of the mediastinum are to be thought of.

*Treatment.*—A differential diagnosis of the type suggests at once the method of treatment. This condition is a comparatively infrequent complication of operative surgery and for this reason the experience of the average surgeon in its treatment is necessarily limited. The lightning-like rapidity with which it attacks the patient already severely handicapped often overwhelms both the patient and the attendant. The treatment may be divided into the prophylactic and the active. Prophylactic treatment should consist of the following measures: careful manipulation of the patient's jaw by the anæsthetist to avoid trauma to the gland. A rigid and careful mouth toilet of every patient prior to anæsthesia. Any infection of the gums should be painted with tincture of iodine. Dryness of the mouth should be prevented after operation. This can be best accomplished by supplying fluids liberally to the patient either by rectum or by hypodermoclysis. The needles for giving fluids by hypodermoclysis can be left with safety in the patient for four or five days and a pint of fluid given every three or four hours, thus avoiding the pain and discomfort of reinserting the needles each time. The patient may be allowed to suck ice or better still lemon stick candy, the acid of the lemon stimulating the salivary secretion.

A case of parotitis having developed, it is quite essential that we early determine the type with which we are dealing. If the simple acute, the application of either ice bags to the gland or hot fomentations will suffice. Opinion differs as to which is the better. The application of an ointment of belladonna and ichthyol to the parotid region which is covered with oiled silk and then hot fomentations seems to give relief to a certain extent. Alpine light therapy may be of benefit.

If possible to open the mouth one should see that the duct is open by

manipulation or probing. If obstruction is met with assure yourself by palpation or X-ray that stone is not present. Patency of the duct must be maintained if possible by probing or splitting the opening of the duct. Operation for drainage of the gland becomes imperative as soon as it appears probable that the gland infection is not going to subside spontaneously or in those cases in which we are dealing with an acute suppurative type from the start as evidenced by the clinical picture. Owing to the toughness of the capsule it is difficult to demonstrate fluctuation. Doubtful cases should be drained not later than forty-eight hours from the onset to avoid suppuration and gangrene, as well as possible rupture into the throat or external auditory canal. Where necrosis has occurred the convalescence will be slow and one has a long-continued, tedious, painful dressing case. Continuous moist heat is valuable at this stage.

The method of incision of Lilienthal I believe to be the safest and best. This consists of a vertical skin-deep incision extending from in front of the auricle and just as close to it as possible. The incision is extended to the hollow behind the angle of the jaw and thence in a gentle curve forward as far as the projection of the anterior border of the masseter muscle. The flap of skin thus formed is reflected forward revealing the greater part of the parotid gland with its overlying fat and fascia. Incisions, as many as appear necessary, may now be made through the parotid fascia into the gland itself the line radiating in a general way along the course of the pes anserinus. No incision, however, should cross the line of Stenson's duct. Deeper collections of pus may be evacuated through the same cutaneous incision by puncturing through the fascia behind the ramus of the jaw and then enlarging the opening with a director or dressing forceps.

Case Reports.—Case I.—Male, aged thirty-six, admitted June 5, 1928, streptococcic cellulitis of left leg complicated by acute nephritis and diabetes mellitus; incision and drainage. On nineteenth hospital day, swelling of left parotid gland noted with severe pain and difficulty in swallowing. At end of forty-eight hours, incision, no pus, followed by subsidence of swelling. After four days, swelling and tenderness of right parotid gland developed which, under heat, subsided after three days. Patient died thirty-eight days after original admission.

Case II.—Male, aged forty, admitted June 20, 1928; severe general abdominal pain; no localization at any time; stools fluid and frequent; abdomen distended from tympanites; temperature normal; pain subsided end of fourth day; simultaneously (tenth day of illness) developed sharp pain and swelling in right parotid region; elevation of temperature to 103.2°; incision of gland evacuated large amount of pus, drainage; forty-eight hours later, right peritonsillar abscess opened and drained, spontaneous escape of pus through right external auditory canal; from this point, uneventful convalescence.

Case III.—Woman, aged twenty-five, admitted July 7, 1928; salpingectomy and appendectomy; morning of second post-operative day pain with moderate swelling and tenderness over both parotids; iced fomentations for one day, then changed to hot fomentations; relief after forty-eight hours; four days from onset swelling and pain had disappeared; temperature normal.

Case IV.—Woman, aged twenty, admitted March 11, 1928; hysterectomy and appendectomy; forty-eight hours after operation, right parotid swollen and tender; oil of wintergreen applications over gland with little relief; fourth day heat applied; sixth day

local condition aggravated, condition stationary for four days; twelfth day right side of face and neck greatly swollen, no pain; Alpine light applied, heat continued, temperature normal.

CASE V.—Man, aged sixty-six, admitted May 22, 1928; cancer of rectum; preliminary colostomy; removal of rectum by transsacral route; eleventh post-operative day left parotid gland swollen and tender; general failure with death fourteen days post-operative.

CASE VI.—Woman, aged twenty-three, admitted November 22, 1926; bilateral salpingectomy and appendectomy; morning of day after operation, parotid gland swollen and tender, ice bags, gradual subsidence of pain and swelling with both glands normal by fifth day post-operative.

CASE VII.—Woman, aged thirty-one, admitted January 24, 1927; cholecystectomy and appendectomy three years previously; now admitted because of pain throughout abdomen; abdominal distention and tenderness; no operative interference; gradual improvement in abdominal pain and tenderness. On third day, swelling and tenderness in right parotid region; ice bag applied; increase of local pain; fifth day entire right side of face and neck, including right eye, swollen and tender but not very painful; belladonna ointment; seventh day temperature normal, swelling subsiding, recovery.

CASE VIII.—Man, aged forty-nine, admitted May 28, 1928, ruptured appendix, general peritonitis, appendectomy, multiple drainage. Hypodermoclysis normal salt solution each day post-operative; fourth day pain and tenderness left parotid region; parotid gland swollen; fifth day pain and tenderness and swelling in right parotid gland; ice bags; pain and swelling in both glands gradually subsiding and by tenth day condition had entirely subsided.

CASE IX.—Woman, twenty-one years, admitted April 3, 1927, appendectomy for chronic appendicitis; second day post-operative swelling and tenderness in right parotid region; rapid swelling and pain in gland and face; dry heat applied; following morning marked increase in symptoms; ichthyol and belladonna ointment applied with dry heat; following day dry heat discontinued, hot moist packs applied; by sixth day swelling and pain greatly decreased, temperature normal; uneventful recovery.

CASE X.—Boy, aged thirteen, acute suppurative appendicitis; appendectomy with drainage; uneventful course for eight days; on eighth day developed pain and swelling in right parotid gland; gland became quite swollen and painful; temperature elevated for five days; gradually dropped, reaching normal on fourteenth day post-operative with subsidence of swelling and disappearance of pain; recovery.

CASE XI.—Man, aged sixty, admitted December 9, 1925; acute gangrenous appendicitis; appendectomy with multiple drainage; diffuse peritonitis; tenth day post-operative marked swelling of left parotid gland with pain; thirteenth day swelling of gland had diminished; general condition bad; death of patient.

CASE XII.—Girl, aged nine, admitted August 14, 1929, acute gangrenous appendicitis; appendectomy, drainage; on twentieth day post-operative after apparent normal wound course pain and tenderness developed in region of right parotid gland; questionable whether the condition was one of mumps or was a mild post-operative parotitis; after two days left side of face was œdematous, slightly tender with normal temperature, pulse and respiration; from this point on the convalescence was uncomplicated.

CASE XIII.—Man, nineteen years, fracture of ribs and vertebræ, traumatic; laminectomy. Three days post-operative right parotitis developed; following day this was bilateral; general condition of patient bad; patient died five days after operation.

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# BLEEDING GASTRIC AND DUODENAL ULCERS*

## REPORT OF 52 CASES

By J. William Hinton, M.D.

of New York, N. Y.

FROM THE SURGICAL SERVICE OF BELLEVUE HOSPITAL

In discussing bleeding ulcers, confusion may arise unless one definitely states to which type of case one is referring. This presentation will include only those cases that have had one or more gross hæmorrhages that were severe enough to confine the patients to the hospital. Cases in which an occasional tarry stool has occurred, or those in which occult blood has been found in the gastric or stool examination, are excluded. During the past nineteen and one-half years, or from January 1, 1911, to July 1, 1930, there have occurred fifty-two cases of bleeding ulcers in the Fourth Surgical Division at Bellevue Hospital. These cases have been divided according to the year of hæmorrhage to determine whether there has been an increase in the frequency during recent years, and Table I will reveal a marked increase

Table I

*Year in Which Hæmorrhage Occurred*

| | | | |
|---|---|---|---|
| 1911 | 4 | 1922 | 0 |
| 1912 | 1 | 1923 | 1 |
| 1913 | 2 | 1924 | 3 |
| 1914 | 1 | 1925 | 2 |
| 1915 | 1 | 1926 | 2 |
| 1916 | 1 | 1927 | 3 |
| 1917 | 0 | 1928 | 10 |
| 1918 | 1 | 1929 | 13 |
| 1919 | 0 | 1930 | 6 |
| 1920 | 0 | | — |
| 1921 | 1 | Total | 52 |

during the past two and one-half years. During this period twenty-nine hæmorrhages occurred, or over 50 per cent. of the total. A paper[2] on acute perforated ulcers, which included 105 cases from the Fourth Surgical Division from 1911 to 1929, revealed one perforation in 1911 as against thirteen for 1929. Whether this increase in complications is due to more conservative treatment of ulcers during the past few years I would not attempt to say, but Eusterman, in discussing a recent paper of Balfour's[1] in which 500 consecutive cases of duodenal ulcer were studied in which gastroenterostomy alone was done during the years of 1918 and 1919, stated: "The fact that 87 per cent. of patients with duodenal ulcer had complete cure or satisfactory relief is a commendable showing. That such cases are safeguarded from

* Read before the New York Surgical Society, November 26, 1930.

future perforation and to a large degree from further hæmorrhage and that subsequent disturbances are easily controlled is worthy of note."

The cases with which we are here concerned have been divided according to the month in which the hæmorrhage occurred, and in Table II it will be

TABLE II

*Month in Which Hæmorrhage Occurred*

| | | | |
|---|---|---|---|
| January | 5 | August | 4 |
| February | 11 | September | 4 |
| March | 4 | October | 3 |
| April | 5 | November | 2 |
| May | 6 | December | 4 |
| June | 2 | | — |
| July | 2 | Total | 52 |

noted that eleven cases, or one-fifth of the total number, occurred in February. It was thought advisable to further divide the cases into three groups: Group I, cases that died with or without operation; Group II, cases not followed since leaving the hospital; and Group III, cases under observation.

*Group I.*—There have been six deaths in cases not operated upon and four deaths following operations for bleeding ulcers. Of the six cases that died without operation, it is interesting to note that four of these had negative gastric histories. In spite of transfusions and other supportive measures, these cases resulted in fatalities and their conditions were such that operative intervention could not have been done. (See Table III.) There were also four post-operative deaths in cases operated upon for bleeding ulcers. In studying these cases it would seem that Case I, Table IV, should have been given a trial at medical treatment. Case III, Table V, with a definite ulcer at operation, which consisted of gastroenterostomy and appendectomy, died from pneumonia and no evidence of the ulcer was found at autopsy, this indicating that the ulcer had completely healed within five days. In view of

TABLE III

*Cases of Bleeding Ulcers Not Operated upon Resulting in Death*

| No. | Date | Age | Sex | Past history | Location of lesion | Previous treatment |
|---|---|---|---|---|---|---|
| 1 | July 8, 1911 | 60 | M | Pain for nine months, vomiting blood, and blood in stools several days. | Duodenum | None |
| 2 | December 14, 1925 | 43 | M | Operated for perforated ulcer, November, 1922. Symptom-free until past six months. Now pain after meals. On admission to hospital vomited blood. | Duodenum | Operation |
| 3 | March 11, 1927 | 35 | M | Pain in abdomen and vomiting for nine days but no blood. | Duodenum | None |
| 4 | March 23, 1927 | 51 | F | Vomiting blood twelve hours. | Duodenum | None |
| 5 | August 8, 1927 | 44 | M | Vomiting blood six hours. | Gastric | None |
| 6 | August 20, 1929 | 56 | M | Bleeding from rectum seven days. | Gastric | None |

TABLE III—*Continued*

| No. | Stay in hospital | Treatment in hospital | X-rays | Autopsy |
|---|---|---|---|---|
| 1 | 4 days. Died, July 12, 1911. | Infusions and hypodermoclysis. | None | Yes |
| 2 | 4 days. Died, December 18, 1925. | Infusions and one transfusion, 500 cubic centimeters. | None | Yes |
| 3 | 4 days. Died, March 15, 1927. | Profuse hæmorrhage, died within two hours. | Negative | Yes |
| 4 | 6 hours. Died, March 23, 1927. | Infusion. | None | Yes |
| 5 | 2 days. Died, August 10, 1927. | Transfusion, August 8, 1927, 500 cubic centimeters. Transfusion, August 9, 1927, 500 | None | Yes |
| 6 | 3 days. Died, August 23, 1929. | Infusions, transfusions, August 21, 1929, 500 cubic centimeters. Transfusion, August 23, 1929, 800 cubic centimeters. | None | Yes |

TABLE IV

*Cases of Bleeding Ulcers Operated upon That Died*

| No. | Date | Age | Sex | Past history | Location of lesion | Previous treatment |
|---|---|---|---|---|---|---|
| 1 | May 8, 1928 | 34 | M | Seven years ago attacks began, with pain after meals for a few months. Another attack five years ago. Two weeks ago had a third attack, vomiting coffee-ground material and tarry stools. On leaving Cornell Clinic the day of admission, fainted and was brought to hospital. | Duodenum | No regulated treatment, visited Cornell Clinic and X-rayed |
| 2 | February 6, 1929 | 48 | M | Pain after eating with belching of gas for twenty-five years. Vomiting at intervals for two years. Tarry stools for seven days. Day of admission became dizzy, weak, and fainted. | Duodenum | No regulated treatment |

| No. | Stay in hospital | Treatment in hospital | X-rays | Autopsy |
|---|---|---|---|---|
| 1 | 3 days. Died, May 11, 1928. Lobar pneumonia. | Operation, May 9, 1928, gastroenterostomy. | Duodenal ulcer | No |
| 2 | 35 days. Died, March 11, 1929. Pneumonia. | February 9, 1929. Transfusion, 500 cubic centimeters. Operation, March 8, 1929, partial gastrectomy. | Duodenal ulcer, March 5, 1929 | Yes |

TABLE V

*Cases of Bleeding Ulcers Operated upon That Died*

| No. | Date | Age | Sex | Past history | Location of lesion | Previous treatment |
|---|---|---|---|---|---|---|
| 3 | April 22, 1929 | 32 | M | Pain after meals for one month. Tarry stools for several days. | Duodenum | No regulated treatment |
| 4 | February 3, 1930 | 59 | M | Epigastric pain for one year. Positive X-rays for eight months before admission. Losing weight and vomiting blood for several days. | Gastric | Advised as to diet |

TABLE V—*Continued*

| No. | Stay in hospital | Treatment in hospital | X-rays | Autopsy |
|---|---|---|---|---|
| 3 | 14 days. Died, May 6, 1929. Lobar pneumonia. | Operation, May 1, 1929, gastroenterostomy, appendectomy. Found on anterior surface of first portion of duodenum an indurated area in which crater could be felt. | April 28, 1929, duodenal ulcer | Yes. No evidence of duodenal or gastric ulcer. |
| 4 | 27 days. Shock. | Operation, February 28, 1930. Partial gastrectomy. Transfusions, February 11, 1930, 500 cubic centimeters; February 13, 1930, 750 cubic centimeters; February 22, 1930, 600 cubic centimeters; February 28, 1930, 500 cubic centimeters. | June 26, 1929, ulcer of lesser curvature. Pars media | No |

this fact, it might seem as if more conservative operations in Cases II and IV would not have been advisable.

*Group II.*—There were twenty-one cases in this group. Four cases which were operated upon for bleeding ulcers have not been followed. The type of operation can be seen in Table VI. There are four other cases that have

TABLE VI

*Cases Operated upon for Bleeding Ulcers But Not Followed*

| No. | Date | Age | Sex | Past history | Location of lesion | Previous treatment |
|---|---|---|---|---|---|---|
| 1 | May 15, 1911 | 47 | F | Pain in abdomen and vomiting of food for thirteen years. Vomiting food on admission. | Pyloric | No regulated medical treatment |
| 2 | October 6, 1911 | 21 | M | Indigestion and abdominal pain for ten months. Vomiting of blood day of admission. | Ulcer not found at operation | None |
| 3 | October 10, 1918 | 25 | F | Gastric hæmorrhage three years before admission on two occasions. Pain for six months. Vomiting blood day of admission. | Gastric | None |
| 4 | May 1, 1924 | 35 | M | Pain and discomfort for six months. Vomited blood just before admission. | Gastric | None |

| No. | Stay in hospital | Treatment in hospital | X-rays | Follow-up |
|---|---|---|---|---|
| 1 | 18 days. Discharged, June 3, 1911. | Operation, May 18, 1911. Gastroenterostomy. | None | Not followed |
| 2 | 27 days. Discharged, November 3, 1911. | Operation, October 9, 1911. Gastroenterostomy. | None | Not followed |
| 3 | 60 days. Discharged, December 10, 1918. | Operation, November 14, 1918. Partial gastrectomy. | October 25, 1918, ulcer of lesser curvature | Not followed |
| 4 | 40 days. Discharged, June 9, 1924. | Infusions for hæmorrhage. Operation, May 27, 1924. Gastroenterostomy. | May 20, 1924, ulcer of lesser curvature | Not followed |

been operated upon for chronic ulcers without pre-operative histories of hæmorrhages but which have bled post-operatively. In Table VII, Case IV, it is interesting to note that for eighteen years following a gastroenterostomy for pyloric obstruction, the patient was symptom-free, after which time he

TABLE VII

*Cases That Have Bled Since Being Operated upon for Chronic Ulcers*

| No. | Date | Age | Sex | Past history | Location of lesion | Previous treatment |
|---|---|---|---|---|---|---|
| 1 | February 27, 1916 | 32 | M | Stomach trouble four years. After operation symptom-free for six months. Pain for three months. Vomiting of blood for five weeks. | Gastric | Operated upon for acute perforated ulcer, May 29, 1915. Simple closure |
| 2 | August 15, 1926 | 32 | M | Pain for several years. After operation symptom-free until one month ago. Now has pain and vomiting blood for one month. Also blood in stools. | Gastric and duodenal | Operation, April 1, 1926, gastroenterostomy. Followed. Sippy diet since operation |
| 3 | February 27, 1929 | 27 | M | Stomach trouble ten years. Operated upon twice. Vomiting of blood few hours before admission. | Duodenal | Operated upon, November, 1924, exploratory. April, 1926, gastroenterostomy |
| 4 | April 19, 1928 | 61 | M | Operated upon, June 20, 1910, Carney hospital, Boston, for duodenal ulcer with pyloric obstruction. Well until two weeks ago. First noticed tarry stools followed in few days by abdominal pain which has continued. Stools continued tarry and this A. M. vomited blood. | Duodenal | None since operation |

| No. | Stay in hospital | Treatment in hospital | X-rays | Follow-up |
|---|---|---|---|---|
| 1 | 11 days. Discharged, March 10, 1916. | Rest and Sippy diet. Operation advised. Refused. | March 8, 1916, ulcer of lesser curvature. | Not followed |
| 2 | 3 days. Left, August 18, 1926, at own request. | Sippy diet and one infusion. | March 15, 1926, gastric and duodenal ulcer | Not followed |
| 3 | 36 hours. February 28, 1929. | Vomiting blood four hours before leaving. Left at own request, February 28, 1929. | March 10, 1926, duodenal ulcer | Not followed |
| 4 | 28 days. Discharged, May 17, 1928. | Sippy diet. | May 10, 1926, gastroenterostomy, stoma normal; duodenal deformity | Not followed |

TABLE VIII

*Cases Treated for Bleeding Ulcer But Not Followed*

| No. | Date | Age | Sex | Past history | Location of lesion | Previous treatment |
|---|---|---|---|---|---|---|
| 1 | February 25, 1911 | 30 | M | Pain in upper abdomen for one year. Vomiting blood two days and vomiting. | Duodenal | None |
| 2 | July 21, 1911 | 19 | M | Pain for four weeks. Vomiting blood twenty-four hours. | Gastric | None |
| 3 | October 19, 1911 | 40 | F | Discomfort for a few months. Vomiting of blood for twelve hours. | Gastric | None |
| 4 | January 19, 1912 | 19 | F | Pain in epigastrium for two weeks. Bleeding from rectum and vomiting blood four days. | Gastric | None |

TABLE VIII—*Continued*

| No. | Stay in hospital | Treatment in hospital | X-rays | Follow-up |
|---|---|---|---|---|
| 1 | 32 days. Discharged, March 27, 1911. | Infusions and diet. | None | Not followed |
| 2 | 2 days. Discharged, July 23, 1911, at own request. | Hypodermoclysis. | None | Not followed |
| 3 | 7 days. Discharged, October 26, 1911, at own request. | Diet and infusions. | None | Not followed |
| 4 | 60 days. Discharged, March 18, 1912. | Horse serum and infusions. Bled for seven days after admission. | None | Not followed |

had a profuse hæmorrhage, whereas Case II began hæmorrhaging only three and one-half months following the operation. This leaves thirteen cases of bleeding ulcers that were treated by conservative measures but have not been

TABLE IX

*Cases Treated for Bleeding Ulcers But Not Followed*

| No. | Date | Age | Sex | Past history | Location of lesion | Previous treatment |
|---|---|---|---|---|---|---|
| 5 | September 28, 1913 | 31 | F | Pain in upper abdomen three weeks. Vomited blood three weeks before admission and on admission. | Gastric | None |
| 6 | November 30, 1913 | 29 | F | Pain in abdomen after meals for three months. Vomited blood one week before admission and tarry stools since. | Duodenal | None |
| 7 | February 13, 1914 | 27 | M | Abdominal pain six days. Vomiting blood and tarry stools three days. | Gastric | None |
| 8 | September 7, 1915 | 32 | F | Pain in upper abdomen for thirteen years. Vomited blood and in hospital thirteen years ago for same. No other bleeding until six hours before admission; vomited blood. | Duodenal | For hæmorrhage thirteen years ago |

| No. | Stay in hospital | Treatment in hospital | X-rays | Follow-up |
|---|---|---|---|---|
| 5 | 14 days. Discharged, October 11, 1913. | Fluids by mouth, ice cap to abdomen and infusions. | October 9, 1913, gastric ulcer lesser curvature | Not followed |
| 6 | 55 days. Discharged, January 23, 1914. | Horse serum, December 3, 1913, 20 cubic centimeters; horse serum, December 4, 1913; transfusion, December 6, 1913, 900 cubic centimeters. | January 10, 1914, duodenal ulcer | Not followed |
| 7 | 17 days. Discharged, March 2, 1914. | Horse serum, February 14, 1914, 20 cubic centimeters; infusions and diet. | March 27, 1914, gastric deformity, lesser curvature | Not followed |
| 8 | 75 days. Discharged, November 18, 1915. | Horse serum three times; infusions and diet. | September 16, 1915, duodenal deformity | Not followed |

followed since leaving. See Tables VIII, IX and X. One case in this group is of interest. Case VIII, female, aged thirty-two years, had a gastric hæmorrhage thirteen years before admission and was treated in a hospital at the time but was symptom-free until six hours before admission.

TABLE X

*Cases Treated for Bleeding Ulcers But Not Followed*

| No | Date | Age | Sex | Past history | Location of lesion | Previous treatment |
|---|---|---|---|---|---|---|
| 9 | January 13, 1924 | 38 | M | Pain in epigastrium for one year. Vomiting of blood twenty-four hours. | Duodenal | None |
| 10 | February 13, 1927 | 28 | M | Pain in abdomen and vomiting blood twenty-four hours. | Duodenal | None |
| 11 | September 1, 1928 | 32 | M | Negative. | Duodenal | None |
| 12 | August 12, 1929 | 38 | M | Negative. | Duodenal | None |
| 13 | November 19, 1928 | 30 | M | Pain in abdomen for eight months. Tarry stools for two weeks. | Pyloric | None, except examinations |

| No. | Stay in hospital | Treatment in hospital | X-rays | Follow-up |
|---|---|---|---|---|
| 9 | 8 days. Discharged, January 21, 1924. | Transfusion, January 15, 1924, 900 cubic centimeters. | January 20, 1924, duodenal ulcer | Not followed |
| 10 | 1 day. Left at own request, February 14, 1927. | Sippy diet. | None | Not followed |
| 11 | 20 days. Discharged, September 20, 1928. | Hypodermoclysis, September 1, 1928, September 2, 1928, September 3, 1928; Sippy diet. | September 18, 1928, duodenal ulcer | Not followed |
| 12 | 3 days. Left at own request, August 15, 1929. | Infusions and Sippy diet. | None | Not followed |
| 13 | 7 days. Discharged, November 26, 1928. | Infusions and Sippy diet. | November 22, 1928, pyloric ulcer | Not followed |

*Group III.*—There are now twenty-one cases of bleeding ulcers under observation in the Gastro-enterological Clinic of the Fourth Medical and Surgical Divisions. Of this number seven have been operated upon for bleeding ulcers. See Tables XI, XII and XIII. Case I has been operated upon twice for a bleeding ulcer: the first operation being a gastroenterostomy done in March, 1924, after which the patient continued to bleed, and a second operation, which was purely an exploration, performed August, 1927. The patient has been symptom-free for the past three years. By the greatest

TABLE XI

*Cases Operated upon for Bleeding Ulcers*

| No. | Date | Age | Sex | Past history | Location of lesion | Previous treatment |
|---|---|---|---|---|---|---|
| 1 | January 23, 1924 | 57 | M | (1) Bleeding from rectum ten days, also vomiting blood. Six years ago similar attack. Another four years ago. No pain or abdominal discomfort.<br>(2) Bleeding from rectum.<br>(3) Well until four days ago. Tarry stools and vomiting blood.<br>(4) Well since last discharge until today. Tarry stools and vomiting blood. | Duodenal | Treated for hæmorrhage on two occasions at home |

TABLE XI—*Continued*

| No. | Stay in hospital | Treatment in hospital | X-rays | Follow-up |
|---|---|---|---|---|
| 1 | January 23, 1924 to February 21, 1924. Re-admitted, February 28, 1924. Discharged, March 24, 1924. Re-admitted, September 5, 1926, to September 24, 1926. Re-admitted, August 18, 1927, to October 7, 1927. | (1) January 25, 1924, transfusion, 600 cubic centimeters.<br>(2) Operation, March 6, 1924, gastroenterostomy.<br>(3) Transfusion, September 7, 1926, 400 cubic centimeters.<br>(4) Transfusion, August 20, 1927, 500 cubic centimeters.<br>(5) Operation, September 16, 1927, exploratory, found normal gastroenterostomy with duodenal ulcer but nothing done. | February 20, 1924, duodenal ulcer<br>September 31, 1926, stoma normal<br>January 4, 1929, gastroenterostomy. Stoma normal<br>May 15, 1930, gastroenterostomy. Stoma normal | No pain, vomiting or tarry stools since last operation. Last seen, September 11, 1930 |

stretch of the imagination the last operation could not have been a factor in the patient's condition during this period of time. Case VI also was of interest, as he had first a pyloroplasty for hæmorrhage and pain in December, 1925, then two years later, in January, 1928, a partial gastrectomy for pain, and again in December, 1929, he had several profuse hæmorrhages. There

TABLE XII

*Cases Operated Upon for Bleeding Ulcers*

| No. | Date | Age | Sex | Past history | Location of lesion | Previous treatment |
|---|---|---|---|---|---|---|
| 2 | February 2, 1928 | 30 | M | Six years ago pain and vomiting of blood and tarry stools. Medical treatment. Well two and one-half years, then another attack. Present attack one week ago, vomiting blood and tarry stools. | Duodenal | Modified Sippy diet |
| 3 | April 29, 1928 | 37 | M | No history of abdominal pain. Vomiting blood and tarry stools three days before admission. Admitted in shock. | Duodenal | None |
| 4 | September 6, 1928 | 30 | M | (1) Patient has had pain for eight years after meals. Vomited blood day before admission.<br>(2) Since leaving hospital, pain after meals and tarry stools daily. | Duodenal | In hospital eight years ago in California for three weeks. |

| No. | Stay in hospital | Treatment in hospital | X-rays | Follow-up |
|---|---|---|---|---|
| 2 | February 2, 1928 to March 25, 1928. | February 9, 1928, transfusion, 500 cubic centimeters. February 10, 1928, operation, cauterization of ulcer, gastroenterostomy and appendectomy. | February, 7, 1928, duodenal ulcer<br>April 4, 1930, deformity first portion duodenum. Stoma normal | March 6, 1930, symptom-free since operation. Last seen, July 31, 1930 |
| 3 | April 29, 1928 to June 19, 1928. | April 29, 1928, transfusion, 500 cubic centimeters. May 5, 1928, transfusion, 500 cubic centimeters. June 1, 1928, operation, cauterization of ulcer, gastroenterostomy and appendectomy. | May 20, 1928, duodenal ulcer. July 15, 1930, duodenal deformity. Stoma normal | Symptom-free since operation. Last seen, October 2, 1930 |
| 4 | September 6, 1928 to September 24, 1928. Re-admitted, October 25, 1928 to November 9, 1928. | (1) On Sippy diet, developed severe pain. Diagnosis, perforated ulcer. Operation, September 9, 1928, exploratory, no ulcer found, nothing done.<br>(2) Operation, October 26, 1928, cauterizing of ulcer, gastroenterostomy and cholecystectomy. | September 25, 1928, duodenal ulcer | After leaving hospital first time would not follow diet, used alcohol frequently. Returned, January 5, 1929, not following diet |

TABLE XIII

*Cases Operated Upon for Bleeding Ulcer*

| No. | Date | Age | Sex | Past history | Location of lesion | Previous treatment |
|---|---|---|---|---|---|---|
| 5 | August 27, 1927 | 42 | M | Pains after eating for two years. Black stools at intervals. Vomiting blood before admission. | Duodenal | None |
| 6 | December 1, 1929 | 31 | M | Pain in abdomen after meals for eleven to twelve years. Hæmorrhage, December 17, 1925. | Duodenal | December 17, 1925, transfusion, 700 cubic centimeters for hæmorrhage. Operation, December 28, 1925. Finney pyloroplasty. Re-operated upon January 8, 1928. Partial gastrectomy. Post-graduate Hospital. |
| 7 | January 29, 1930 | 45 | M | Pains after meals for two years. Blood in stools and vomiting three hours before admission. | Duodenal | None |

| No. | Stay in hospital | Treatment in hospital | X-rays | Follow-up |
|---|---|---|---|---|
| 5 | 31 days. August 27, 1927 to September 28, 1927. | Infusions and operation, September 1, 1927. Gastroenterostomy. | February 7, 1930, ulcer first portion duodenum. Stoma normal | Symptom-free since operation. Last seen, August 2, 1930 |
| 6 | 24 days. Discharged, December 24, 1929. | Transfused, December 4, 1929, 500 cubic centimeters; transfused, December 9, 1929, 500 cubic centimeters. | August 15, 1930, partial gastrectomy. Stoma normal | Symptom-free since leaving hospital. Last seen, October 2, 1930 |
| 7 | 36 days. Discharged, March 6, 1930. | Transfused, January 29, 1930, 600 cubic centimeters; transfused, January 31, 1930, 500 cubic centimeters; transfused, February 3, 1930, 350 cubic centimeters; transfused, February 10, 1930, 500 cubic centimeters; Operation February 14, 1930. Excision of ulcer and gastroenterostomy. | September 27, 1930, stoma normal. Duodenal deformity | Symptom-free. Last seen, October 2, 1930 |

are five cases that have bled while being treated for chronic ulcers under medical management in the clinic. Although they were progressing satisfactorily before the hæmorrhages they required hospital care while bleeding but have not been operated upon. Since their hæmorrhages they have re-

TABLE XIV

*Cases That Bled Under Medical Treatment in the Clinic*

| No. | Date | Age | Sex | Past history | Location of lesion | Previous treatment |
|---|---|---|---|---|---|---|
| 1 | April 28, 1928 | 26 | M | Pain after meals for seven years. Tarry stools two weeks before entering hospital. | Duodenal | Treated by physician before entering clinic, on milk diet. |
| 2 | March 16, 1929 | 56 | M | Pain and discomfort in abdomen for ten years. | Duodenal and gastric | No regulated treatment before entering clinic |
| 3 | March 23, 1929 | 43 | M | Pain after meals for one month. | Duodenal | No regulated treatment before entering clinic |

TABLE XIV—*Continued*

| No. | Stay in hospital | Treatment in hospital | X-rays | Follow-up |
|---|---|---|---|---|
| 1 | From October 6, 1929 to October 17, 1929. | Sippy diet, ice cap to abdomen. Transfusion, 500 cubic centimeters. | April 23, 1928, duodenal ulcer. October 26, 1928, same. October 23, 1929, same. March 15, 1930, same | No bleeding since leaving hospital but slight pain every few weeks. Last seen April 15, 1930 |
| 2 | From October 26, 1929 to November 17, 1929. | Sippy diet. Transfusion, November 1, 1929, 500 cubic centimeters. Transfusion, November 6, 1929, 500 cubic centimeters. Operation advised, refused. | March 13, 1929, ulcer on lesser curvature and duodenal ulcer. October 15, 1929, same | Had a hæmorrhage, January 5, 1930 and taken to Fordham Hospital. Operation at Mt. Sinai Hospital, February 4, 1930, ca. of stomach. June 14, 1930, no complaints |
| 3 | From September 7, 1929 to September 28, 1929. | Sippy diet. Transfusion, September 9, 1929. Transfusion, September 15, 1929, 500 cubic centimeters. | March 15, 1929, duodenal ulcer. September 8, 1930, duodenal ulcer | October 7, 1930, no bleeding but some pain since leaving hospital, April 10, 1930 |

sumed satisfactory progress under medical care. (See Tables XIV and XV.) There are nine cases that were brought to the hospital for hæmorrhages that are now being followed in the clinic. These cases are, at the present time,

TABLE XV

*Cases That Bled Under Medical Treatment in the Clinic*

| No. | Date | Age | Sex | Past history | Location of lesion | Previous treatment |
|---|---|---|---|---|---|---|
| 4 | May 25, 1929 | 41 | M | No history of abdominal discomfort. History of tarry stools and vomiting blood. | Duodenal | Transfused in January, 1928, also in March, 1929 |
| 5 | April 28, 1928 | 26 | M | Pain and indigestion for six years. | Duodenal | In clinic. Passed tarry stools, January 3, 1929 to January 20, 1929 |

| No. | Stay in hospital | Treatment in hospital | X-rays | Follow-up |
|---|---|---|---|---|
| 4 | January 17, 1928 to February 10, 1928. March 9, 1929 to March 29, 1929. | Sippy diet and transfusions. | January 21, 1928, negative. March 21, 1929, duodenal ulcer. November 29, 1929, duodenal ulcer | No bleeding since March 9, 1929 |
| 5 | April 25, 1929 to May 29, 1929. Profuse hæmorrhage ten days after operation for acute perforation. | Operation, April 25, 1929. Transfusion, May 5, 1929, 500 cubic centimeters. | April 8, 1928, duodenal ulcer. September 16, 1929, duodenal ulcer. April 3, 1930, duodenal deformity | Symptom-free. Last seen, August 28, 1930 |

symptom-free. (See Tables XVI, XVII and XVIII.) Careful laboratory work has been done on all the bleeding cases. Each case has had a gastric analysis, complete blood count, bleeding and clotting time, clot retraction time, platelet counts, complete blood chemistry including urea nitrogen, N. P. N., creatinine, chlorides, sugar, calcium and phosphorus, also urinalysis, Wasser-

TABLE XVI

*Cases That Bled Without Previous Treatment*

| No. | Date | Age | Sex | Past history | Location of lesion | Previous treatment |
|---|---|---|---|---|---|---|
| 1 | April 14, 1928 | 60 | M | Vomiting blood and tarry stools a few hours before admission. | Duodenal | None |
| 2 | December 30, 1928 | 32 | M | (1) Pain after meals for two months. (2) Gained forty pounds. No complaints until two months before admission. Vomiting blood seven days. | Gastric. Lesser curvature | None |
| 3 | February 24, 1929 | 46 | F | Treated twenty-five years ago in Bellevue Hospital for an ulcer of stomach. In hospital few weeks. Symptom-free until two weeks ago; since then pain; vomiting blood two hours before admission. | Duodenal | Hospital treatment for ulcer twenty-five years ago. Well for twenty-five years |

| No. | Stay in hospital | Treatment in hospital | X-rays | Follow-up |
|---|---|---|---|---|
| 1 | May 14, 1926 to May 26, 1926 | Sippy diet and infusions. | May 25, 1926, duodenal ulcer. December 8, 1928, negative | No vomiting of blood or tarry stools. Symptom-free, March 9, 1929 |
| 2 | December 30, 1928 to January 16, 1929. Re-admitted August 30, 1930 to September 13, 1930 | (1) January 7, 1929, transfusion, 450 cubic centimeters. Sippy diet. (2) September 7, 1930, transfusion, 500 cubic centimeters. Sippy diet. | January 15, 1929, ulcer on lesser curvature of stomach. September 9, 1930, G. I. Negative. September 10, 1930, chest negative | Last seen, September 25, 1930 |
| 3 | February 24, 1929 to March 9, 1929 | Sippy diet; hypodermoclysis. | March 8, 1929, duodenal ulcer. August 2, 1929, duodenal ulcer. July 22, 1930, negative | No vomiting or tarry stools. Symptom-free. Last seen, July 31, 1930 |

mann and stool examination. All work was essentially negative except a low hæmoglobin and red blood count.

*Summary.*—Of the fifty-two cases reported in this paper, there were ten deaths, six of which were in cases treated by conservative measures, the deaths occurring in spite of supportive treatment. There were four post-operative

TABLE XVII

*Cases That Bled Without Previous Treatment*

| No. | Date | Age | Sex | Past history | Location of lesion | Previous treatment |
|---|---|---|---|---|---|---|
| 4 | March 31, 1929 | 29 | M | (1) Pain in epigastrium for six or seven years. (2) Vomiting blood two days. | Pyloric | None |
| 5 | November 23, 1929 | 26 | M | One year ago operated upon for chronic appendicitis. Going to work fainted on subway steps and cut his face. Vomited blood. | Duodenal | None |
| 6 | May 10, 1929 | 41 | F | Pain after meals for three years which was relieved by soda. Vomiting blood and tarry stools for two days. | Duodenal | None |

TABLE XVII—*Continued*

| No. | Stay in hospital | Treatment in hospital | X-rays | Follow-up |
|---|---|---|---|---|
| 4 | March 31, 1929 to May 10, 1929. Re-admitted February 21, 1930 to March 11, 1930 | (1) Sippy diet and infusions. (2) Sippy diet and infusions. | April 15, 1929, pyloric ulcer. Refused others | Patient began treatment May 11, 1929. Discontinued in a few weeks. Second hæmorrhage, February 21, 1930. Returns irregularly. |
| 5 | November 23, 1929 to December 16, 1929 | Transfusion, November 27, 1929, 500 cubic centimeters. Sippy diet. | November 30, 1929, ulcer, first portion of duodenum. August 5, 1930, duodenal ulcer | No complaints, except occasional pain. Last seen, October 2, 1930 |
| 6 | May 16, 1929 to May 24, 1929 | Infusions and Sippy diet. | May 20, 1929, duodenal ulcer. March 11, 1930, duodenal ulcer | Gained fifteen pounds. No bleeding, only slight pain. Last seen, September 25, 1930 |

deaths, and it would seem that in two cases more conservative operations should have been done. In the twenty-one cases that have been operated upon or treated conservatively, but which have not been followed, there is little information that can be gained from the study of this group, except that the patients were discharged improved. Of the twenty-one cases now under observation in the clinic, it is interesting to note that five of these were being treated for chronic ulcers and progressing satisfactorily when they hæmorrhaged severe enough to confine them to the hospital while under our care.

TABLE XVIII

*Cases That Bled Without Previous Treatment*

| No. | Date | Age | Sex | Past history | Location of lesion | Previous treatment |
|---|---|---|---|---|---|---|
| 7 | January 4, 1930 | 22 | M | Abdominal pain for six months. Tarry stools for two weeks. | Duodenal | None |
| 8 | February 1, 1930 | 47 | M | Fainted and fell at work; received lacerated scalp. Two dizzy spells few days before. Tarry stools after entering hospital. | Duodenal | None |
| 9 | March 1, 1930 | 31 | F | Pain in upper abdomen for twelve years. Vomiting of blood and tarry stools nine years ago. In bed ten days. Repeated about every three years since. Last two days ago. | Duodenal | Modified Sippy diet |

| No. | Stay in hospital | Treatment in hospital | X-rays | Follow-up |
|---|---|---|---|---|
| 7 | January 4, 1930 to January 10, 1930 A. O. R. | Infusion and Sippy diet. | January 20, 1930, duodenal ulcer | April 10, 1930. Social Service visit, moved |
| 8 | February 1, 1930 to February 20, 1930 | Transfusion, February 11, 1930, 500 cubic centimeters. Transfusion, February 15, 1930, 500 cubic centimeters. | March 8, 1930, duodenal deformity. July 15, 1930, negative | Improved, no complaints. Last seen, July 17, 1930. Gained ten pounds |
| 9 | March 1, 1930 to March 6, 1930 A. O. R. | Hypodermoclysis and Sippy diet. Transfusion refused. | April 10, 1930, duodenal ulcer | Improved, no complaints. Last seen, June 6, 1930 |

Also, two cases have been operated upon for bleeding ulcers but have continued to bleed since their operations. During this period of nineteen and one-half years there have been ten full-attending surgeons responsible for the treatment of these cases and in view of that it would seem the treatment has been fairly uniform and the mortality of 19 per cent. not unduly high.

*Comment.*—After studying these cases, it may seem confusing to determine how bleeding ulcers should be treated, but, as has been noted, the cases of acute hæmorrhages that proved fatal in spite of conservative treatment usually occurred in patients with negative or short gastric histories. The cases with chronic recurring hæmorrhages can usually be controlled by conservative treatment but whether they are permanently cured cannot be stated at present. Surgery seems indicated in chronic hæmorrhages if the patient is incapacitated at frequent intervals. The type of operation can be decided upon only after exploring the lesion, but if possible the ulcer should be cauterized or excised, plus whatever operative procedure may seem indicated. It is very questionable whether partial gastrectomies are ever indicated in bleeding lesions, either of the stomach or duodenum.

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# SACRAL CHORDOMA

By James A. Dickson, M.D., and Charles A. Lamb, M.D.
of Cleveland, Ohio
From the Department of Orthopædic Surgery of the Cleveland Clinic

In the present paper, the writers offer another authentic case of chordoma to add to the rather meagre number now reported. A review of the literature has revealed accounts of only slightly more than eighty cases of all varieties. Most of these have been situated, as was this one, in the sacral area, the next most frequent site being the spheno-occipital region, although in the past few years some cases occurring along the spine at various levels have been reported. Probably, chordoma is not so rare as the number of reported cases indicates, many such tumors being either overlooked or incorrectly diagnosed.

*History of the Case.*—This patient was a man aged forty-one, a manufacturer, who came to the clinic September 10, 1929, complaining of pain in the lower part of his back. This pain began in December, 1928. It was very mild at first, but increased slowly in intensity. It was of a constant boring character not affected by activity, and interfered with the patient's sleep. Heat, aspirin, and periods of rest had failed to give relief and after months of annoying and unrelievable pain in the lower spine, occasionally radiating down the left leg, a consultation was sought.

The findings on physical, laboratory, and X-ray examinations were negative, except for a tender area the size of a fifty-cent piece over the lower third of the sacrum exactly in the mid-line. This area could be definitely delimited, and neither pressure over the surrounding parts nor manipulation of the lumbosacral or sacro-iliac joints produced any pain. Rectal examination revealed a bulging area on the anterior surface of the sacrum in its lower third which was tender and semifluctuant. There was no fixation of the soft tissues, and the coccyx was free and movable and not painful.

Exploration, September 14, 1929, revealed a tumor mass, yellowish, soft, and very friable, which protruded from the posterior surface of the sacrum and extended through to its anterior surface, the area of bone erosion being about 2 centimetres in diameter. A portion of the tissue was removed for pathological study, and frozen sections were made at this time but were not sufficiently clear to permit of a diagnosis. The tumor was curetted out as thoroughly as possible, its bed was packed with vaseline gauze, and the wound was closed.

Our pathologist, Dr. Allen Graham, reported that macroscopically, the specimen consisted of numerous grayish-pink pieces of tissue, soft, friable, and of a somewhat gelatinous consistency. Microscopically, the appearance of the tumor tissue was variable. There were areas in which small and large solid nests, strands, and masses of tumor cells were lying in a homogeneous pink-staining mucoid stroma. The tumor cells varied considerably in size and shape. In general, they were made up of a large amount of homogeneous, pink-staining cytoplasm, containing a relatively small, round, spindle-shaped, or irregular nucleus. The nuclei were vesicular, and had well-defined nucleoli. The cell outlines were not distinct. There were large masses of multinucleated cytoplasm which had the appearance of syncytial tissue. The cytoplasm was vacuolated in many instances. In some areas the tissue was made up of compact masses of spindle cells, forming fibrillæ and whorls, little of the mucoid stroma being present, and the picture was not unlike that seen in a fibroma or fibrosacroma. The nuclei of the cells

were variable in size and shape, and a few mitotic figures and irregular nuclear divisions were observed. In other areas there was a mixture of the two histological types described above. In a few areas the arrangement of the tissue was somewhat suggestive of cartilage.

The pathological diagnosis was *sacral chordoma.*

September 19, 1929, the sacrum was radiated with 900 r-units. The patient was discharged from the hospital September 22, 1929. He was free from pain, but there was a slight seropurulent discharge from the wound. Subsequently he reported regularly for dressings and observation until March 10, 1930. Although there had not been any return of discomfort nor any external evidence of a recurrence of the tumor up to

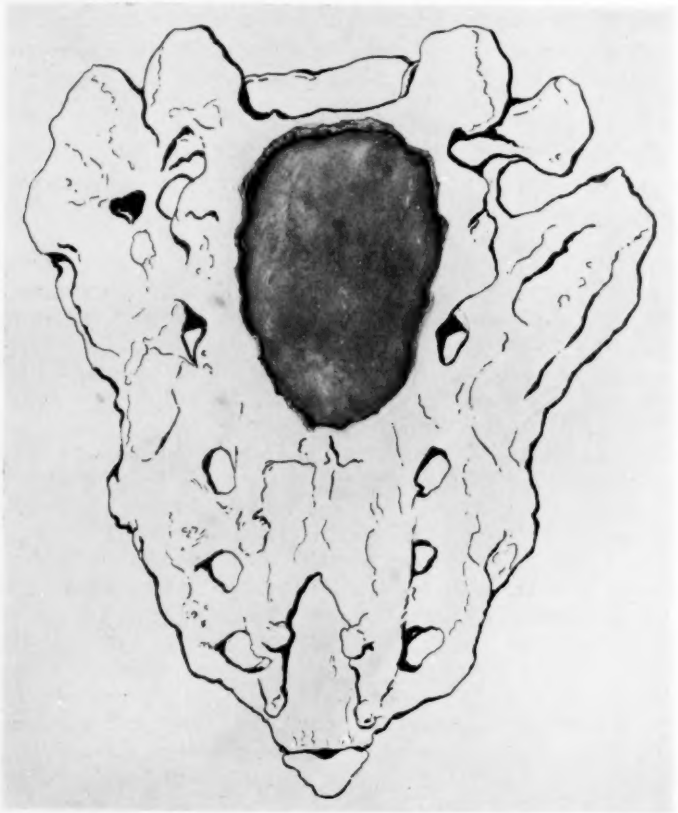

FIG. 1.—Drawing of sacrum showing the relative size and position of the chordoma at the time of the second operation.

this time, on rectal examination a mass was palpable which seemed to be slowly increasing in size. Another attempt at complete excision was therefore advised.

The second operation was performed March 27, 1930. Pre-operative rectal examination revealed a sessile mass in the hollow of the sacrum, about the size of a silver dollar and approximately 8 millimetres thick. The centre of this mass felt softer than the surrounding portion.

The old scar over the sacrum was excised. Considerable scar tissue was found under the skin. The spines of the sacrum were exposed with the periosteal elevator, and the ligamentous structures were reflected. There was a small opening into the sacral canal of about 1½ by 3 centimetres. Through this could be seen a soft mass, bluish-gray in color. The roof of the sacrum was cut away by rongeurs, leaving an opening

5 by 10 centimetres in size. The whole of the sacral canal was filled with a fairly firm, bluish-gray tumor mass, which was remarkably avascular except at the periphery (Fig. 1). In the lateral portion of the mass, bundles of tissue could be seen which were identified as the sacral nerves. The tumor apparently filled the entire sacral canal, and was intimately associated with the sacral nerves. It was deemed inadvisable, therefore, to attempt to remove it because of the probability that these nerves would be injured. A rectal examination was made at this juncture, and pressure was applied to the anterior aspect of the tumor in the hollow of the sacrum. This mass could be seen and felt to bulge slightly just to the left of the mid-line at about the mid-portion of the sacrum. The patient made a satisfactory operative recovery and was discharged from the hospital April 6, 1930.

Post-operative treatment consisted of deep X-ray therapy in doses of 160 r-units on April 26, May 3, May 10, May 24, and June 10, 1930. During this time the tumor progressively decreased in size, and gradually became harder and more calcified.

When last examined, September 9, 1930, the patient had continued free from pain, and rectal examination revealed that the tumor was definitely smaller, while all tenderness had disappeared. The X-ray treatments apparently had been successful in checking the development of the neoplasm. Metastasis is rare in this type of tumor, and none has been found in this case.

Chordoma is a tumor arising from cellular remains of the notochord, occurring, therefore, along the spine, most frequently at its extremities. It is composed of epithelial tissue, and is of endothelial origin.

As far back as 1856 Luschka described a case of chordoma, but did not recognize its origin or importance. Müller in 1858 suggested that the notochord was perhaps the origin of these tumors. The name "chordoma" was suggested by Ribbert in 1894. The development of our present knowledge has occurred almost entirely during the past thirty years, more particularly since 1922, when Professor Matthew J. Stewart, of Leeds, presented the first case recognized in Britain. In 1926 Professor Stewart collected fifty-seven reported cases, and in 1929 reports of only eighty cases had appeared in all the medical literature, and even some of these are questionable.

The average age at the onset of these tumors is from thirty-five to forty years, although cases have occurred as early as one and a half and as late as seventy-nine years. Spheno-occipital chordomas appear, on the average, ten years later than sacrococcygeal chordomas.

Males are twice as prone as females to develop these tumors, which suggests the part that trauma may play in their etiology. As a matter of fact, they have been produced experimentally in rabbits by puncturing the body of a vertebra.

The first symptom noticed usually is mild pain in the sacrum or lower portion of the spine, located exactly in the mid-line. Pain may radiate down the legs or into any region upon the nerve supply of which the growth encroaches. Relief cannot be obtained by the ordinary therapeutic measures, and the pain gradually increases until sleep becomes almost impossible. While the tumor may be discovered before the occurrence of pain, more often it is found as a result of the pain. The mass may protrude principally within the bony pelvis, and thus escape detection unless the sacrum is palpated

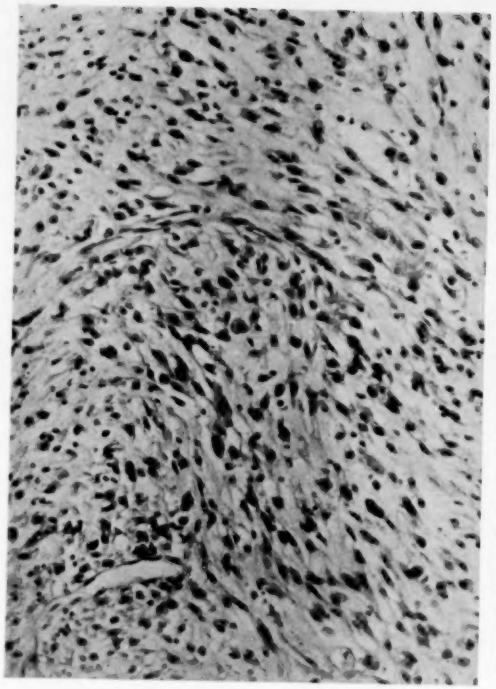

FIG. 2.—View of a section, X 150, showing the spindle-cell type of tissue.

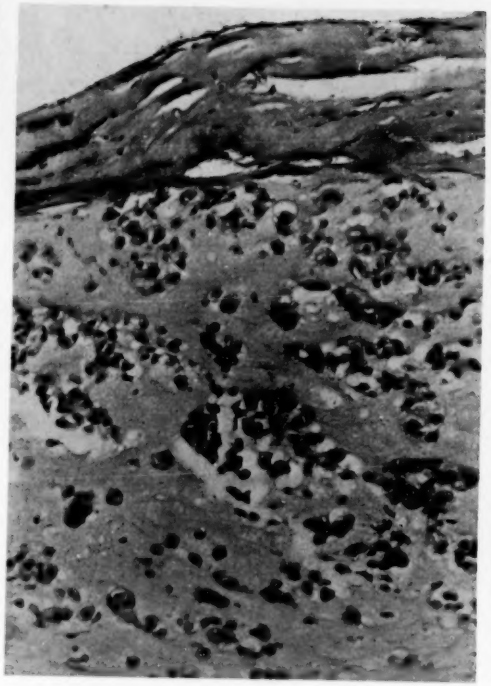

FIG. 3.—View of a section, X 150, showing the fibrous capsule of the tumor and the cartilage-like tissue with mucinous stroma.

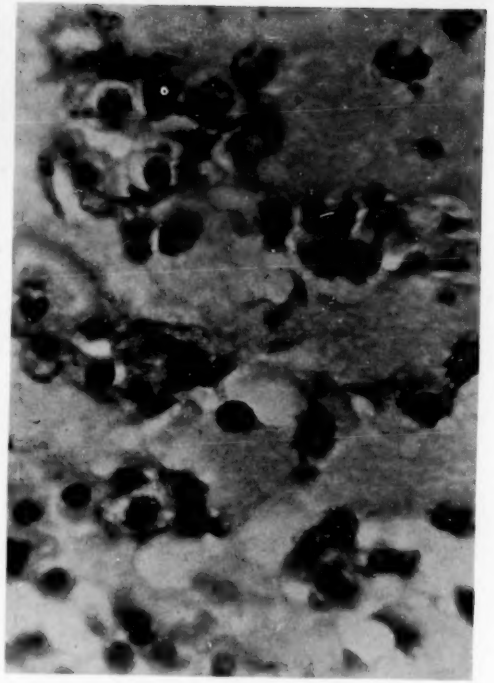

FIG. 4.—View of a section, X 600, showing the syncytial-like masses of cells with vacuolated cytoplasm.

by rectum. Chordomas grow very slowly, but their persistence has been regarded as certain.

Usually there are no symptoms except those caused by mechanical pressure. The diagnosis is suggested by the history of pain in the lower spine or skull and by the finding of a palpable tumor mass, semifluctuant in character. A positive diagnosis, however, can be made only by the microscopic appearance.

In 1926, Stewart and Morin described the gross appearance of these tumors in detail. The growth is well encapsulated, rounded, and lobulated. Gross section appears lobulated, and the lobules show mucoid degeneration, often of an advanced character. Frequently, cells of syncytial type are embedded in a sea of mucin. Some areas resemble colloid carcinoma, others cellular carcinoma. The salient microscopic features described by Stewart are as follows: alveolar character of growth; solid epithelial aspect of the younger cellular areas; cytoplasmic and intercellular vacuolation; formation intracellularly of mucinous fluid, which escapes from the cells to form, first, intercellular columns and, later, mucin in which only scattered cellular islets remain; rarity of mitotic figures except in very malignant cases. Chordomas are malignant only in a low degree, but occasionally they metastasize.

Although in the great majority of cases reported so far radiation has not helped, from the results in this case it is our opinion that the X-ray, in sufficient dosage, has greater possibilities than surgery. The end-result of our case, of course, is uncertain, but the improvement thus far has been satisfactory. The size of the tumor has decreased, the tissues have hardened, and all symptoms have disappeared.

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# THE SURGICAL TREATMENT OF SOME CONGENITAL ABNORMALITIES OF THE GENITO-URINARY TRACT*

By Waltman Walters, M.D.

of Rochester, Minnesota

from the division of surgery of the mayo clinic

The most frequent congenital defects and abnormalities of the genito-urinary tract are hydronephrosis, undescended testicles (cryptorchidism), exstrophy of the bladder, hypospadias and epispadias. I think it can be accepted without debate that the surgical treatment of these abnormalities produces not only satisfactory, but, in many instances, surprisingly excellent, results.

In discussing the treatment of hydronephrosis, I intend to emphasize the benefits which can be obtained from conservative operations, such as (1) division of anomalous blood-vessels obstructing the passage of urine from the kidney into the ureter, (2) resection of hydronephrotic renal pelves, preserving the kidney and establishing complete and efficient drainage of the kidney, and (3) division and reinsertion of the ureter into the dependent portion of a hydronephrotic renal pelvis.

In the treatment of exstrophy of the bladder and complete epispadias, with absence of urinary sphincters and lacking urinary control, transplantation of ureters into the rectum and the removal of the malformed bladder have changed the lives of the patients from one of embarrassment and seclusion to one of satisfactory progress. The rectum serves as a reservoir for collection of urine, efficiently controlled by a competent anal sphincter.

The undescended testicle (the condition of cryptorchidism) should be brought down and placed in the scrotum before the age of puberty, preferably between the ages of six and ten years, and by some method which will maintain the testicle in the depth of the scrotum, away from the spine of the pubic bone. Such a testicle placed in the normal position in the scrotum before puberty will increase normally in size, and should function satisfactorily, not only from the standpoint of the production of internal secretion from interstitial cells, but also from the standpoint of spermatogenesis.

Similarly, the surgical treatment of hypospadias and epispadias should be carried out at an early age, before puberty, and in our experience the best results are obtained in children between six and nine years of age. In the cases of hypospadias, the curved penis should be straightened, and then later advancement of the urethra or the plastic development of an urethra from the adjacent skin will, in many instances, give satisfactory results.

At this time, however, I wish to discuss in detail only cases of hydronephrosis, exstrophy of the bladder and cryptorchidism in which I have

* Read before the Inter-State Postgraduate Medical Association of North America, October 20, 1930.

operated at The Mayo Clinic in the course of the last six years. The group includes twelve cases of exstrophy of the bladder, fourteen cases of hydronephrosis in which plastic operations have been successfully carried out, and thirty-six cases of undescended testicle. The patients in the first two groups have been carefully studied prior to and following operation so that the results obtained will be accepted, I believe, as evidence of what may be expected from such procedures.

*Hydronephrosis.*—Early work on plastic surgery of the hydronephrotic renal pelvis was done by Küster and by Fenger. The former advocated that a ureter which was laterally placed and was inefficiently draining the hydronephrotic pelvis be reimplanted in the dependent portion of the pelvis. He carried this out successfully in one case. Fenger suggested and carried out a plastic operation at the constricted ureteropelvic juncture, similar to the Heineke-Mikulicz pyloroplasty. The operation consisted of a longitudinal incision through the constricted portion which was sutured transversely. In 1917, impetus was given to plastic procedures on the renal pelvis by the report of a case by W. J. Mayo, in which, following most difficult pelviolithotomy, by accident, he completely detached the renal pelvis from the kidney. He reattached it to the kidney with interrupted sutures of catgut and covered the line of suture with a fatty fascial flap, and good union and function followed. Eight years before, W. J. Mayo, Braasch and MacCarty had reported a group of twenty-seven cases with hydronephrosis in which a plastic operation of the Heineke-Mikulicz type was successfully accomplished in nine cases. The following year this number had increased to sixteen.[8] In 1922, Quinby reported three cases of hydronephrosis, and in 1927, seven cases in which the ureter of the hydronephrotic renal pelvis was successfully transplanted to its dependent portion. At the Portland meeting of the American Medical Association in 1929, in collaboration with Braasch, I reported a group of four cases in which I had successfully resected hydronephrotic renal pelves; Braasch had studied the pyelograms and the renal function before and after the operations. In that group was one patient who had bilateral hydronephrosis with infection. Prior to his operation, over a period of years, he had had a history of intermittent renal colic with chills, fever and lumbar pain. At first this had been controlled by drainage by ureteral catheter, but later this method became ineffective. The pelvis of the right kidney, with a capacity of 150 to 250 cubic centimetres of infected urine, and the left, of larger size, were resected two years ago, and the operations have been followed with excellent results. He has been reëxamined within the last two months, and is in excellent condition, without further evidence of hydronephrosis or urinary retention in the kidneys.

When the hydronephrosis is bilateral, conservation of renal function becomes necessary. There have been five additional patients with bilateral hydronephrosis, one of whom has had the second renal pelvis successfully resected. The other four have had one renal pelvis resected and are waiting

a lapse of two or three months for the plastic operation on the other kidney.[15] In an additional case, in a woman with bilateral hydronephrosis, there was huge dilatation of the pelvis and calices of the left kidney. An attempt was made to reduce the size of the kidney by first establishing adequate drainage from the kidney into the ureter, and secondly, by the introduction of a tube through the cortex into the renal pelvis by nephrostomy. Angulation of the ureter by peripelvic connective tissue was the cause of the obstruction at the ureteropelvic juncture; this was successfully overcome by division of this peripelvic tissue. The pelvis and calices of this kidney have decreased in size more than 75 per cent. since these surgical procedures, as shown by pyelograms. It may be possible in selected cases to carry out similar procedures satisfactorily rather than to resect the pelves.

*Exstrophy of the Bladder.*—Although exstrophy of the bladder is not common, 100 patients with this congenital abnormality have been operated on at the clinic in the last thirty years. Seventy-three of these patients have been operated on by a method described in 1917 by C. H. Mayo. The method consists of transperitoneal transplantation of the ureters into the sigmoid, using a principle which Coffey[2] described in transplantation of the common bile duct. The lower end of the ureter, for a distance of 2.5 to 3 centimetres, is carried in the wall of the sigmoid, between the muscular and mucosal layers of the intestine, so as to secure a valve-like action. This method, in our experience at the clinic, has been attended by an extremely low mortality rate, and the evidences of ascending infection into the kidneys are almost wholly lacking, even after a period of as long as fifteen or twenty years following the operation. In two instances, following successful procedures of this type, the patients, who were women, were married and gave birth to children. One of these patients, a graduate nurse, gave birth to twins by Cæsarean section; the other was delivered of a normal baby at full term. Many of the patients operated on have been adults, but the best time to carry out the operative procedure is before the age of puberty. It is important, however, that the patients be at least four years of age and that they shall have obtained sphincteric control of the fæces. Although of late, bilateral simultaneous transplantation of the ureters into the sigmoid has been suggested and carried out in some cases,[3] in our experience, the safest procedure in children has been to transplant one ureter at a time. Preferably, the right ureter is transplanted at the first operation, and ten days or two weeks later, the left; ten days following, the bladder can be removed. Of the seventy-three patients on whom both ureters have been transplanted, three died in hospital, a mortality of 4.1 per cent. Sixteen other patients have been operated on by various methods: six by the method of bilateral simultaneous transplantation of Coffey, two by the method of Moynihan, and in eight cases a unilateral transplantation was done. These cases are not included in the series of seventy-three. In the series of twelve cases of exstrophy of the bladder which I am reporting, there have been no deaths.

*Undescended Testicles (Cryptorchidism).*—The preferable age for operation on these patients is between six and nine years. The testicle may lie within the abdomen, in the inguinal canal, or at the external inguinal ring. All cases of intra-abdominal testicle are associated with hernia, and in many instances in which the testicles are in the inguinal canal, a hernial sac is present. This hernial sac must be excised and the inguinal canal must be partially closed as a part of the plastic operation for cryptorchidism. One of the prerequisites for a satisfactory operation for cryptorchidism is that after the division of connective tissue around the vas deferens and the spermatic artery, the structures of the spermatic cord be of sufficient length to enable one to place the testicle in some part of the scrotum. In addition, it must be so placed in the scrotum that it is not in contact with the spine of the pubic bone, where it is more susceptible to injury than if it were intra-abdominal or in the inguinal canal. In any operative procedure intended adequately to correct the position of undescended testicles, the scrotum should be stretched to sufficient size to allow the testicles to be placed in its dependent portion, which keeps the testicles away from the spine of the pubic bone. In our experience, two operative procedures satisfy these requirements. In one, which is used by Cabot, traction is placed on the testicle and part of the scrotum by an elastic rubber band which is tied to a suture that extends through the gubernaculum and lower part of the scrotum; the rubber band is temporarily fastened to a metal crutch that bears on the perinæum in such a way that traction can be maintained. A second method which we have found to be very successful is similar to a method described by Keetley, and by Torek, and popularized by Meyer. It consists of an operation in two stages. At the first stage the testicle is brought out through an incision in the scrotum and is attached to the fascia lata of the thigh. Following this procedure, the patient is able to return to work or other activities within a period of two weeks. Two or three months later, or at any convenient time thereafter, the second stage of the operation is carried out, in which the scrotum is separated from the skin of the thigh and the testicle from the fascia lata of the thigh. It will then be found that the testicle can be replaced in the depth of the dilated portion of the scrotum when the incision of the scrotum or thigh is closed. The patient is usually able to leave the hospital the day following the second stage of the operation, which can be carried out satisfactorily under local anæsthesia.

## SUMMARY

In pre-operative and post-operative studies of patients on whom plastic operations for hydronephrosis have been accomplished, indications are that a conservative operation for hydronephrosis can be carried out successfully if sufficient renal parenchyma remains. These plastic operations, in my experience, have consisted for the most part of resection of the hydronephrotic portion of the renal pelvis and changing the angle of insertion of the ureter so that it completely and satisfactorily drains the dependent por-

tion of the renal pelvis. If the hydronephrosis is bilateral, such conservative procedures are operations of necessity. In a group of fourteen cases in which the renal pelvis has been resected, hydronephrosis was bilateral in five.

In the treatment of exstrophy of the bladder, transplantation of the ureters into the sigmoid, with subsequent removal of the bladder, is followed by excellent results. The rectum serves as a reservoir for the urine and almost without exception the patients on whom the procedure is carried out are able to hold the urine in the rectum without leakage for from four to six hours during the day. Many of them are able to retain the urine in the rectum the entire night. Experience has led us to the belief that the safest method of ureteral transplantation is one described by C. H. Mayo, in 1917, in which the ureters are transplanted separately with an interval of ten days or two weeks between each transplantation. Carrying the ureter between the mucosal and muscular layers of the sigmoid or rectal wall, which is Coffey's principle in transplantation of the common bile duct, has, by valve-like action, prevented ascending infection to the kidneys in practically all of the cases. Clinical evidences of this may be found in the general feeling of "good health" with normal growth in children, and the absence of lumbar pain, chills, or fever. In many cases fifteen to twenty years have elapsed since the ureterosigmoidal transplantation.

In the treatment of undescended testicle the testicle must be placed in the dependent portion of a scrotum of normal size, so that the testicle will not be in contact with the spine of the pubic bone. This has been successfully accomplished by the methods described by Cabot and by Torek. In Cabot's method the scrotum is stretched and the spermatic cord is lengthened by a one-stage operation in which an elastic band is temporarily used as a tractor. Torek's operation is in two stages. In the first stage the testicle is temporarily attached to the fascia lata of the thigh, and the skin of the thigh and the scrotum is attached around the testicle. After the second stage of the operation, when the scrotum is severed from the skin of the thigh and the testicle from the fascia lata of the thigh, the testicle will lie in the dependent portion of a scrotum of normal size. This procedure has been carried out in thirty-six cases with excellent results.

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# SOLITARY CYSTS OF THE KIDNEY

By Charles Clair Higgins, M.D.

of Cleveland, Ohio

from the cleveland clinic

Because of the apparent rarity of solitary cysts of the kidney it seems worth while to report ten cases from the records of the Cleveland Clinic. I use the term "apparent rarity" because it would appear that solitary cysts of the kidney are of more frequent occurrence than we are led to believe from a review of the literature. As Branch[1] states, solitary cysts of the kidney are rarely observed by the clinician but are frequently observed by the pathologist. He states further that unless the cysts reach a sufficient size to produce pressure symptoms, they are rarely diagnosed and are found only at autopsy. Branch states that they are present in from 3 to 5 per cent. of all autopsies. In five kidneys from thirty-six cadavers, Kampmeier[2] found cysts which varied from 2.5 to 5 centimetres in diameter. From 2,610 autopsies at the Middlesex Hospital in London Morris[3] reported five cases of solitary cysts. We have found in the literature reports of 158 cases. The addition of our ten cases brings the total number to 168.

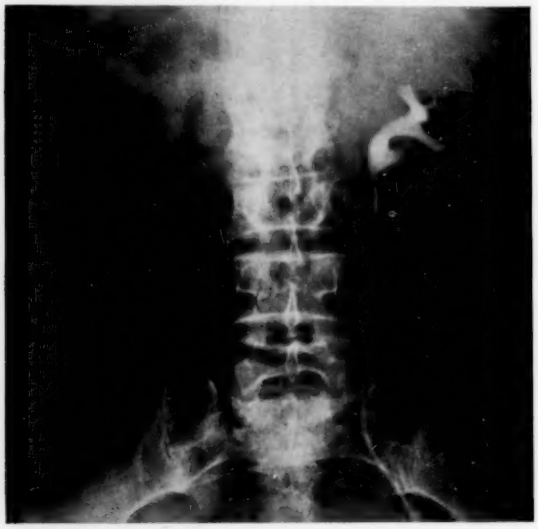

Fig. 1.—Pyelogram showing deformity of calyces of kidney due to solitary cyst.

Case I.—The patient was a woman forty years of age who entered the clinic complaining that during the preceding ten years she had suffered from pain in the right side and difficulty in urination, the latter symptom having followed childbirth. The patient also had a feeling of fulness in the abdomen and an occasional aching pain in the right side. For the preceding few years there had been marked urgency and nocturia. There was no history of hæmaturia.

The physical findings were normal except for a palpable smooth mass in the region of the right kidney. The röntgenogram showed a large round shadow connected to the lower pole of the right kidney. The first pyelogram was normal, but a later one showed a spherical enlargement below the lower pole of the kidney (Fig. 1). Blood-pressure was 120/75, red blood count 4,400,000, white blood count 8,750, hæmoglobin 80 per cent., urine normal, Wassermann negative. The pre-operative diagnosis was cyst of the right kidney. At operation a cyst was found at the lower pole of the right kidney. This was removed together with a wedge of renal parenchyma. Convalescence was uneventful.

CASE II.—A man, sixty-two years of age, entered the clinic complaining of jaundice which had been increasing in intensity during the preceding few weeks, but was not associated with pain. There was marked pruritus and the stools were clay-colored. For years he had been aware of a mass in the right side of the abdomen which had been diagnosed "ptosed liver." It had not caused pain but only a feeling of fulness.

Physical examination revealed a man in very poor physical condition who was quite jaundiced and acutely ill. In the right kidney region was a large round mass the size of a grapefruit, which was not nodular and was soft in consistency. Pyelography was not thought advisable. The blood-pressure was 140/90. Laboratory findings were as follows: hæmoglobin 80 per cent., red blood count 4,030,000, white blood count, 6,950; blood urea 84; blood cholesterol 182; serum bilirubin 3.8 direct; urine—albumin two plus, 2 to 5 pus cells per high-power field, few granular casts; Wassermann negative.

A diagnosis of carcinoma of the head of the pancreas was made and an exploratory operation performed. In addition to carcinoma of the pancreas a large solitary cyst the size of a grapefruit was found at the lower pole of the right kidney. This was aspirated. The patient died a few days later of uræmia.

CASE III.—A man aged seventy-four entered the clinic complaining of nocturia, frequency, difficulty in voiding, and blood in the urine. Recently he had noted terminal hæmaturia. He was poorly nourished; blood-pressure was 130/80. The only important finding on general and cystoscopic examination was marked enlargement of the prostate. *Laboratory findings.*—Hæmoglobin 85 per cent., red blood count 4,350,000, white blood count 5,800; phenolsulphonphthalein 40 per cent. in two hours; blood urea 57; urine—albumin two plus, red blood cells 20 to 30, and white blood cells 2 to 5 per high-power field; Wassermann negative.

A suprapubic prostatectomy was performed, and the patient died four days later of pneumonia. Post-mortem examination revealed a cyst of the lower pole of the right kidney which was filled with light amber-colored serous fluid. Pneumonia was the primary cause of death.

CASE IV.—A man, seventy-nine years of age, entered the clinic complaining of difficulty in voiding. Five years ago he had first experienced increasing nocturia and difficulty in starting the stream which had diminished in size; terminal dribbling was quite pronounced. A poorly nourished man showing evidence of considerable loss in weight. Blood-pressure was 120/80. Heart moderately enlarged and a loud systolic blow was heard at the apex. Rectal examination revealed considerable enlargement of the prostate and cystoscopic examination showed marked intravesical projection of the prostate.

A perineal prostatectomy was performed. The patient died five days later of uræmia and pneumonia.

At post-mortem examination a large solitary cyst 18 centimetres in diameter and filled with serous fluid was found on the anterior surface of the upper pole of the right kidney.

CASE V.—A man, twenty-four years of age, entered the clinic complaining of pain in the left kidney region which had continued intermittently for the preceding year. These attacks came on suddenly, lasting from ten to fifteen minutes and then subsiding. There was no hæmaturia or passing of gravel. Nothing of significance was found in the physical examination; no tumor mass was palpable. The cystoscopic examination led to the diagnosis of calculous pyonephrosis. *Laboratory findings.*—Wassermann negative; blood normal; function test not recorded; urine—numerous pus cells, no red blood cells. A left nephrectomy was performed and in addition to the calculous pyonephrosis a cyst the size of a lemon was found at the lower pole of the kidney. Convalescence was uneventful.

CASE VI.—A man, forty-six years of age, entered the clinic complaining of severe attacks of pain over the right kidney from which he had suffered for several years. The pain radiated downward toward the scrotum. There was no history of hæmaturia or

passing of gravel. Physical findings were normal except for tenderness on deep pressure over the right kidney. *Laboratory findings.*—Wassermann negative, phenolsulphonphthalein 50 per cent. in two hours. Urine—trace of albumin, white blood cells 2-4 per high-power field. A cystoscopic examination was done and a diagnosis of calculous pyonephrosis was made from the pyelogram.

A right nephrectomy was performed at which time a large solitary cyst containing clear, serous fluid, was found at the lower pole of the kidney in addition to the calculous pyonephrosis. This cyst was ruptured accidentally while removing the kidney.

CASE VII.—A woman, forty-five years of age, entered the clinic complaining that for six months she had experienced urinary urgency, frequency every fifteen minutes and nocturia ten to twelve times. One month before entering the clinic she had passed a small amount of blood. There was no history of loss in weight. Two weeks previously she had had an attack of pain in the right side accompanied by chills and fever. She was a fairly well-nourished woman showing no evidence of weight loss. The blood-pressure

FIG. 2.—Photograph showing a large cyst of the right kidney associated with tuberculosis.

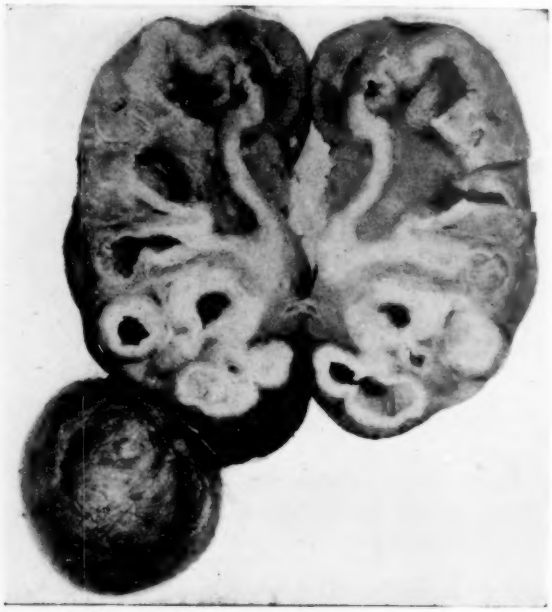

FIG. 3.—Photograph of cut specimen of kidney with cyst attached.

was 130/90. Suprapubic tenderness was present. Vaginal examination revealed a hard, pencil-like, tender lower right ureter. A cystoscopic examination was made and tubercle bacilli were found in the specimen from the right kidney. From the pyelogram a preoperative diagnosis of tuberculosis of the right kidney was made. *Laboratory findings were as follows.*—Wassermann negative; hæmoglobin 70 per cent., red blood count 4,420,000, white blood count 7,800; urine—pus two plus, red blood cells 5-10 per high-power field, phenolsulphonphthalein 18 per cent. in fifteen minutes.

Nephrectomy was performed. The kidney was found to be tuberculous and a solitary cyst larger than an egg and containing yellowish, clear, serous fluid was found in the lower pole. Convalescence was uneventful. (Figs. 2 and 3.)

CASE VIII.—A man, sixty-four years of age, entered the clinic complaining of weakness and loss of weight. His general condition had been very poor for the preceding month and he had lost 20 pounds in weight.

He was very poorly nourished with a generalized glandular adenopathy. Blood-pressure was 124/80. The liver and spleen were both palpable.

*Laboratory findings were as fo'lows.*—Hæmoglobin 70 per cent., red blood count 3,900,000, white blood count 70,000, smear of blood showed 71 per cent. large lymphocytes; urine—albumin one plus, white blood cells two plus; Wassermann negative. A diagnosis of lymphatic leukæmia was made and X-ray therapy was instituted. The patient died two months later. At post-mortem a large solitary cyst filled with clear, serous fluid was found at the upper pole of the left kidney (Fig. 4).

It is interesting to note that a single cyst 3 centimetres in diameter containing clear, serous fluid was also found in the left lobe of the liver (Fig. 5). No other cysts were found.

CASE IX.—A man, fifty-three years of age, entered the clinic complaining of stomach trouble, the symptoms of which had been present during the preceding two years. During this time he had had more or less constant pain in the left lower quadrant which he described as a pulling-down pain. About one year ago he had had an attack of cramp-like pains in the left lower quadrant causing him to double up in agony, and six months previously he had had an acute attack of pain in the lower abdomen accompanied by vomiting.

He was well-nourished. Blood-pressure was 134/80. On physical examination

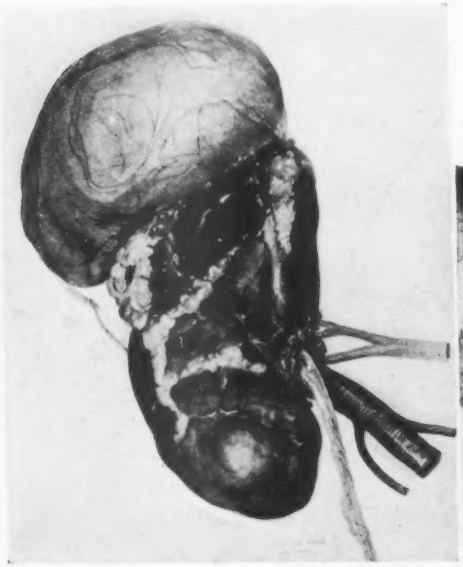

FIG. 4.—Photograph of cyst attached to upper pole of left kidney found post-mortem in a patient who died of lymphatic leukæmia.

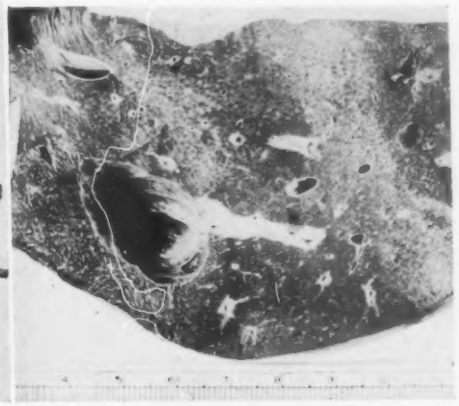

FIG. 5.—Photograph of section of liver in which a cyst was found coincidentally with kidney cyst. (See Fig. 4.)

the only finding of significance was a mass to the left of the umbilicus. This mass was round, movable, and not tender. A pyelogram showed a large mass connected with the lower pole of the left kidney. *Laboratory findings.*—Red blood count 4,780,000, white blood count, 7,800, hæmoglobin 85 per cent; urine normal except for a few pus cells; blood urea 48; phenolsulphonphthalein test showed normal excretion.

A pre-operative diagnosis of solitary cyst of the lower pole of the left kidney was made. At operation a cyst the size of a small grapefruit was found attached to the lower pole of the left kidney (Figs. 6 and 7). This was excised without removing any of the kidney parenchyma. Convalescence was uneventful.

CASE X.—A boy, three years of age, was brought to the clinic because of an enlargement of the abdomen. He had always been healthy but the abdomen had been protuberant since birth (Fig 8).

On physical examination the only significant finding was a large mass the size of a grapefruit in the left hypochondrium. Upon röntgenographic examination this was shown to be a large mass in the region of the left kidney. Kidney function was normal as were the urinary findings. A pyelographic examination was not made.

A pre-operative diagnosis of malignant tumor of the kidney was made. At operation a large cyst 13 by 10 by 9 centimetres filled with serous fluid was found at the lower pole of the left kidney and extending upward on its lateral surface. As the kidney appeared to be atrophic it was removed with the cyst. The kidney and cyst together weighed 570 grams. Convalescence was uneventful.

*Review of the Literature.*—Solitary cysts of the kidney were first described by Fabry[4] in 1624. Thomas Willis,[5] the English clinician, described them in the seventeenth century, and in 1837 Rayer[6] first classified the various types, this classification being followed in 1876 by an excellent treatise by Lavaran[7] in which he discussed the difference between solitary cysts of the kidney and polycystic kidney. In a complete review of the literature in 1906, Simon[8] collected fifty-two cases which had been reported from 1860 up to that time. Later, individual cases were cited and the literature was reviewed by Caulk,[9] Cunningham,[10] Blanchard,[11] Vogel,[12] Beneke,[13] Wulff,[14] Fowler,[15] and others.

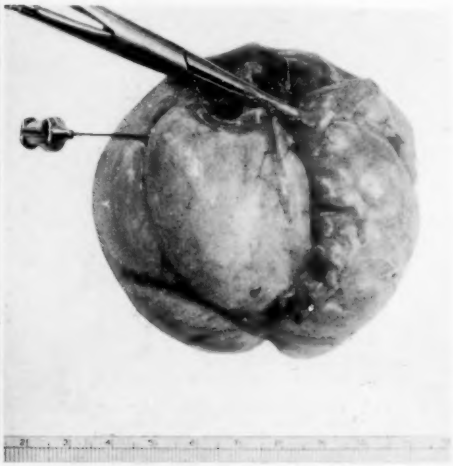

FIG. 6.—Photograph of serous cyst of left kidney. FIG. 7.—Photograph of this cyst after it was removed.

In 1920 Kretschmer[16] again reviewed the literature adding forty-eight cases, including one of his own, to Simon's series, making a total of 100 cases.

McKim and Smith[17] in 1924 collected 117 cases from the literature, and added three. In the same year Harpster[18] presented ninety-five collected cases, in eighty-two of which an operation had been performed with the following results:

In thirty cases nephrectomy was done followed by recovery in twenty-three cases; in thirty-four cases, resection of the cyst alone, or together with a portion of the kidney, resulted in death in three cases or 9 per cent.; in four cases the cyst was tapped followed by death in two cases. In the remaining fourteen cases the type of operation was not stated.

In 1928, Carson[19] collected 126 cases from the literature and added fifteen cases which had been reported between the years 1923 and 1927. These, with four additional cases made a total of 145.

In 1930, Grove[20] collected 153 cases from the literature, and added a case, and Kretschmer[21] recently reported five cases of his own. As we have

FIG. 8.—Photograph of a boy three years old in whose case a diagnosis of malignant tumor of the kidney was made. Operation disclosed a cyst 13 by 10 by 9 centimetres.

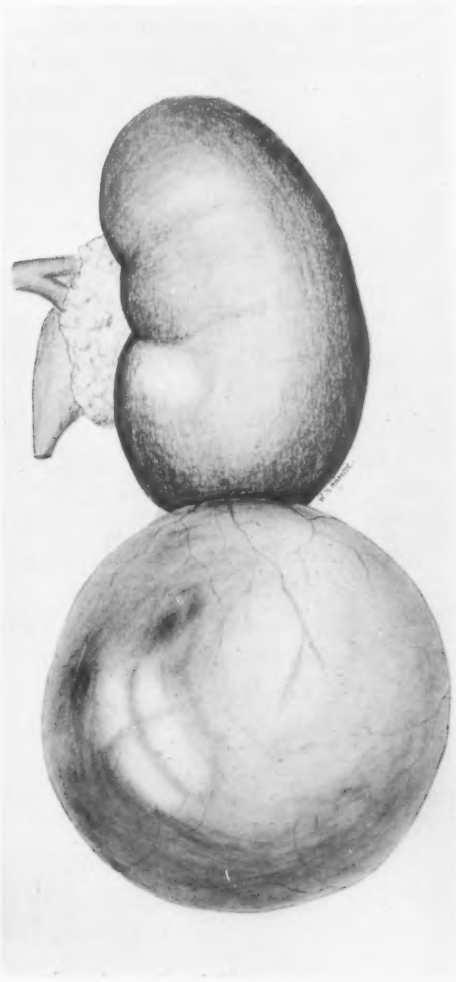

FIG. 9.—Drawing showing a solitary cyst at lower pole of kidney.

stated the addition of the ten cases cited in this paper brings the total number up to 168.

*Structure.*—The wall of a solitary cyst of the kidney is generally grayish-white in color varying from one to five millimetres in thickness. Calcification is rare but may occur as in the case cited by Kirwin.[22] The inner surface is smooth and glistening and fine blood-vessels may be seen coursing through it

(Fig. 9). The wall of the cyst is independent of the capsule of the kidney, although frequently it is closely adherent to it. Some investigators state that the cyst has no epithelial lining while others describe the presence of a single layer of low, cuboidal epithelium. It has even been stated that the lining consists of normal cell formation of uriniferous tubules which, as the result of pressure, may be flattened.

In our series of cases the cell lining of the cysts varied. In one case the lining consisted of flattened cells separated by rather heavy connective-tissue trabeculæ. In another, the cyst wall was composed of fairly dense, fairly well vascularized, simple, fibrous, connective tissue but no epithelial cells were present. If the cyst is large, pressure atrophy may be present in the adjacent kidney tissue.

A cyst usually contains clear, straw-colored, serous fluid the specific gravity of which is low. Hæmorrhage may take place into the cyst, producing blood clots. In one of our cases the fluid had a distinct odor of urine. Fowler states that the fluid contained in a cyst is clear, watery and albuminous, and does not contain urinary elements unless it communicates with the pelvis or calyces of the kidney, which is not the case as a general rule.

*Age Incidence.*—Carson states that the majority of cases of solitary cysts of the kidney occur between the ages of thirty and sixty years, the average age being forty-five. Simon also states that the condition occurs most frequently in the fourth and fifth decades. In Kretschmer's review of forty-two collected cases in which the age was stated, thirty-six cases occurred after thirty years of age. The youngest patient was sixteen months old (reported by Albarran and Imbert). In our series, the youngest patient was three years of age and the oldest seventy-nine. The age incidence in our series was as follows:

| *Age* | *Number of Cases* |
|---|---|
| 3 years | 1 |
| 24 years | 1 |
| 40–50 years | 3 |
| 51–60 years | 1 |
| 61–70 years | 2 |
| 71–80 years | 2 |

*Sex Incidence.*—Of the cases reviewed by O'Neil[23] in the Massachusetts General Hospital, five occurred in men and four in women. Of those reported by Albarran and Imbert[24] thirteen occurred in men and ten in women. In Kretschmer's series of cases twenty occurred in men and twenty-two in women, and in our series eight occurred in men and two in women. In Simon's[8] series, the condition occurred twice as frequently in women as in men. It is also interesting to note that most of the women in which the condition has been present were multiparous. In Carson's[19] series of 146 collected cases, eighty-nine occurred in women, forty-one in men and in sixteen cases the sex was not stated.

*Location and Size.*—In six of the cases herein reported the cyst occurred on the right kidney and in four it was found on the left, while in Kretschmer's collected series, in twenty-one cases the cyst occurred on the right and in twenty on the left kidney. Carson has found that the condition occurs more frequently on the right kidney. Solitary cysts of the kidney are usually unilateral although Cunningham and Zaccarini[25] reported the occurrence of bilateral cysts. It is well known that small cysts are frequently found on arteriosclerotic kidneys but these are not solitary cysts and should not thus be included in this discussion. In the cases reviewed by McKim and Smith the site of the cyst was as follows:

| | *Lower pole of kidney* | *Upper pole of kidney* | *Center of kidney* |
|---|---|---|---|
| McKim and Smith ..... | 51 | 21 | 8 |
| Kretschmer ..... | 13 | 11 | |
| Higgins ..... | 7 | 3 | |

Solitary cysts may arise from the upper or lower pole, the anterior surface or the hilus of the kidney. In most of the cases reviewed herein the cyst was present on the lower pole of the kidney.

The cysts vary in size from a few centimetres in diameter to a large sac containing a litre or more of fluid. In one case in our series the cyst contained over a litre of fluid. Since the smaller cysts present no symptoms they are not found by the clinician, and only at autopsy.

*Associated Pathology.*—In addition to the cyst, various coexisting pathological lesions may be present. In our series a calculous pyonephrosis was present in two cases and caseous tuberculosis in one case. Cunningham reported a case of coexisting renal calculi and also a case of coexisting hypernephroma. Desno cited a case of a solitary cyst which was present in a tuberculous kidney and O'Neil[23] reported a cyst in a horseshoe kidney.

It is also interesting to note that in Case VIII of our series, in addition to the large solitary cyst found in the kidney, a single cyst three centimetres in diameter, containing clear, serous fluid was found in the liver. This was the only other organ in which a cyst was found.

*Etiology.*—Various theories have been advanced in regard to the etiology of solitary cysts of the kidney. Cunningham[10] states that they are probably due to an obstruction in the uriniferous tubules and to the continued excretion of urine without an outlet.

Kampmeier[2] states that normally the human fœtus passes through a period which is characterized by the presence of numerous cystic renal tubules which if they persist and expand at the expense of the adjacent tissue, may cause a renal cyst. Caulk,[9] who studied a large series of these cases, stated that although some cysts may be congenital in origin, it seems evident that the majority are due to obstruction. McKim and Smith[17] believe they may be due to mechanical causes, they may be of neoplastic origin, or they may be congenital.

*Symptomatology.*—Solitary cysts of the kidney do not present any pathognomonic symptoms until they attain sufficient size to produce pressure or until they become palpable. The patient may complain of vague abdominal discomfort, and a sense of fulness, or pain in the region of the kidney. Constipation may be present and urinary symptoms may be entirely absent. Hæmaturia is a rare symptom but it has occurred in cases cited

FIG. 10.—Röntgenogram showing pressure deformity of stomach and duodenum due to solitary cyst of kidney.

by Caulk,[9] Cunningham[10] and O'Neil.[23] In our series, hæmaturia was present in one case but this was believed to be due to congestion and enlargement of the prostate. In another case, the patient had had severe attacks of renal colic which were undoubtedly due to the coexisting real calculi. In a third case marked urinary frequency and dysuria, pyuria and hæmaturia were present but these symptoms were explained by the presence of coexisting renal tuberculosis. Frequently the presence of the tumor is noted by

the patient, as in the cases cited by Cunningham,[10] Kretschmer,[21] Blanchard[11] and in one of the cases cited in this paper.

*Diagnosis.*—Often the condition is not diagnosed prior to operation. Bugbee[26] recently made a pre-operative diagnosis of a solitary cyst in the case of palpable tumor of the kidney. The cystoscopic examination and the functional tests gave normal findings. In two of our cases a correct diagnosis was made prior to operation. The presence of hydrops of the gall-bladder, an ovarian cyst or a tumor of the kidney may cause confusion in making a diagnosis. Lesions of the gastro-intestinal tract, however, can be identified by a complete röntgenographic examination, and cholecystography may be used to eliminate the presence of pathological conditions of the gall-bladder.

The röntgenogram may show the outline of the cyst, especially if it arises from the lower pole of the kidney, but cysts of the upper pole are less readily

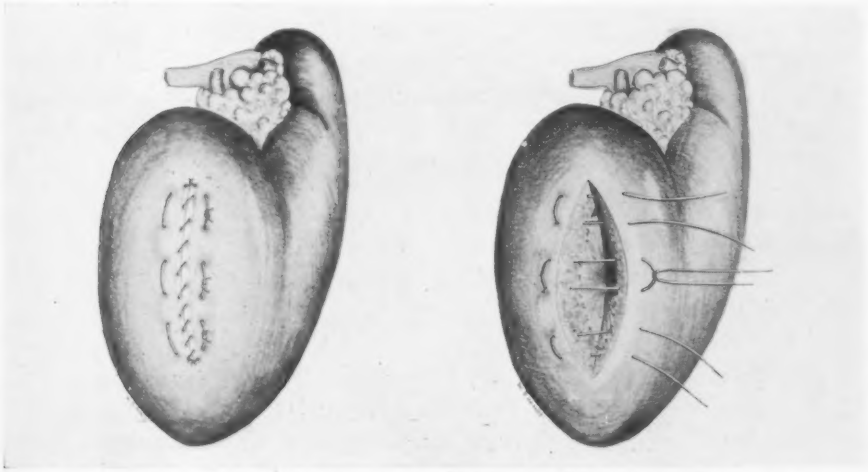

FIG. 11.—Drawing illustrating closure of kidney after removal of cyst.

visualized. The margin of the cyst is continuous with the kidney and there may be a difference in density between the cyst and the kidney. A cyst of the upper pole may attain to such a size that its weight forces the kidney downward, producing ectopia, or the ureter may be displaced from its normal position by the presence of a cyst on the kidney. A gastro-intestinal study may disclose displacement of the colon, stomach or duodenum by the cyst as was noted in one case in this series (Fig. 10).

As the cysts do not communicate with the pelvis or calyces of the kidney the pyelogram may be normal but if the cyst attains sufficient size to bulge into the pelvis a deformity may be shown. The findings from the pyelogram therefore depend upon the size of the cyst, its origin, and the direction in which it grows. In three cases cited by Kretschmer one pyelogram was normal and two were definitely abnormal. Urinalysis and function tests of the kidney usually give normal findings.

*Treatment.*—Conservative renal surgery is especially applicable in the treatment of this pathological condition. The extraperitoneal approach naturally is preferable as adequate exposure can thus be secured. It must be remembered that the wall of the cyst is independent of the kidney capsule although adherent to it. In some cases the cyst can be successfully dissected from the kidney without removing a wedge of kidney tissue, as was accomplished in one case of our series. This is certainly the procedure of choice.

It may be necessary to resect a small wedge of kidney tissue along with the cyst in order to remove all the secreting surface of the cyst (Fig. 11). By an adequate kidney incision an excellent exposure is secured, hæmostasis being controlled by holding the kidney pedicle between the fingers. By releasing pressure upon the pedicle of the kidney spurting blood-vessels may be seen and controlled by catgut sutures. Reapproximation of the wedge-shaped margin of the kidney is accomplished with chromic catgut mattress sutures. Any fatty tisue in the immediate vicinity is then sutured over the incision in the kidney which has been sutured. Nephrectomy should be performed only in the presence of some coexisting pathological condition of the kidney such as a tumor, tuberculosis, or calculi, which has destroyed the renal parenchyma.

## CONCLUSIONS

1. Solitary cysts of the kidney are of more frequent occurrence than is apparent from the literature.

2. A röntgenogram may reveal the presence of a cyst, especially if it arises from the lower pole of the kidney.

3. Pre-operatively, a pyelogram may show a normal kidney, functional tests may be normal and there may be no urinary symptoms.

4. Conservative renal surgery is the indicated treatment for a solitary cyst, either by dissection of the cyst away from the kidney tissue or by the removal of the cyst together with a small wedge-shaped portion of the pole of the kidney. This will then allow adequate approximation of the kidney tissue.

5. Nephrectomy should be performed only in the presence of some coexisting renal pathological condition, such as a tumor, tuberculosis, or calculi, if deemed advisable.

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# ECTOPIC (PELVIC) KIDNEY

By Howard L. Tolson, M.D.
of Cumberland, Md.

Ectopic or congenitally misplaced kidney although of particular interest to urologists is also a subject of interest to those engaged in general medicine, general surgery, gynæcology and obstetrics. The malposed kidney, especially if it is situated in the true pelvis, is quite prone to disease and the resulting symptoms and signs are apt to be misleading. Pain due to pathological processes in a pelvic kidney is likely to direct attention to other organs. Even if there is a palpable mass in the pelvis the true condition may not be appreciated. Although renal dystopia is considered relatively rare, the condition occurs commonly enough* to be borne in mind. Frequently ectopic kidneys are poorly or abnormally developed rendering them more likely to pathological states than normal organs. Any of the pathological conditions that occur in the normally situated kidney may be found in the ectopic kidney. It is probable that the chief features of the case reported herewith are typical of the pelvic ectopic kidney with defective ureteral drainage.

Case History.—A white woman, aged forty-eight years, was admitted to the Memorial Hospital of Cumberland, Md., April 1, 1930, on account of pain in right lower quadrant of her abdomen. She had been married twenty-four years but never pregnant. Her appendix and gall-bladder had been removed in 1928.

For about fifteen years she had been having pain in the right lower quadrant of her abdomen. Until two years ago this pain was of dull aching character, never severe. It was felt chiefly when she was much on her feet; usually she was relieved by lying down. During the past two years she had suffered with attacks of severe colicky pain in right lower quadrant, radiating to thigh. Nausea, vomiting, prostration, severe pain on top of head, and frequency of urination accompanied the attacks. Morphia was required for relief. At first they occurred at intervals of two to three months, but during the past three months there had been four attacks. Between the attacks there was dull aching pain. Occasionally dull aching pain was felt in left lower quadrant.

Menstrual periods were always irregular, occurring at intervals of fifteen days to three months. The flow has always been scanty. Six months ago the last period occurred.

The patient was of slender build, weight 126 pounds. She appeared comfortable at the time of examination. All teeth had been removed. Tongue was heavily coated. The neck was normal. Thorax had abnormal contour, consisting of a prominent bulging of right lower portion anteriorly. The breasts were small and poorly developed. The heart and lungs were normal. The blood-pressure was 130/75.

* H. C. Clark, Eighteenth Annual Report, 1929, p. 274, of the Medical Department, United Fruit Company, stated that among 4215 consecutive autopsies made at the Gorgas Hospital, Canal Zone, a pelvic kidney, either as a unilateral or as a bilateral fused affair, occurred thirteen times. None of them had been recognized clinically.

An operative scar was in the upper right quadrant. No abnormal masses were felt. The kidneys were not palpable and there was no tenderness in the kidney areas. Apparently there was mild diffuse tenderness in right lower quadrant. Tenderness was most marked at McBurney's point.

Pelvic examination revealed an unusually short vagina and a small, firm, nulliparous cervix. The uterus was small and the adnexa were not enlarged. No abnormal mass was felt.

*Cystoscopic Examination April 1, 1930.*—Except for slight hyperæmia in the trigone the entire bladder had a normal appearance. Both ureteral meati were normal in position and size. In the right ureter a No. 7 catheter passed about half the usual distance between the ureter meatus and the renal pelvis and could not be further introduced. Blood-tinged urine dropped slowly from the catheter. A No. 7 catheter after a little difficulty in the pelvic portion of left ureter passed the usual distance to the kidney and drained clear urine. Indigo-carmine was given intravenously and X-ray examination, including right pyelo-ureterogram was made.

*Right Kidney.*—Specimen discolored with blood, (traumatic—the catheter had been manipulated in the ureter in an effort to pass what seemed to be an obstruction in the ureter); microscopic examination showed high-power field filled with erythrocytes, a few leucocytes. Stained smears revealed no bacteria. There was only a faint trace of indigo-carmine in twenty minutes.

*Left Kidney.*—Specimen clear; centrifuged sediment showed a few epithelial cells. Stained smears revealed no bacteria. There was normal indigo-carmine excretion in twenty minutes.

*Cystoscopic Examination April 5, 1930.*—Catheter No. 7 was passed to left kidney and clear urine drained. Phthalein was given intravenously. The left kidney excreted fifteen per cent. phthalein in fifteen minutes. At the end of the fifteen-minute period a catheter in the bladder removed only a few drops of fluid which contained a faint trace of phthalein, indicating very little function from the right kidney during the fifteen-minute period.

*Röntgen Examination* showed no radiable calculus. The left kidney shadow was large. An outline of the right kidney was not seen on the plain film.

*Right Pyelo-ureterogram* (Fig. 1) (4 cubic centimetres sodium iodide solution used) revealed the right kidney in a median position in the true pelvis, opposite the sacrum. The pelvis, of bifid type, was small. A sharp angulation was present at the ureteropelvic juncture. From the ureteropelvic juncture situated a little to the left of the mid-line the short ureter of small calibre coursed to the right and downward.

*Left Pyelo-ureterogram* showed a large left kidney in the lumbar region—pelvis of kidney opposite the body of third vertebra. The pelvis and calices were moderately dilated. A double kink of ureter was present opposite the fourth lumbar vertebra. At a point just above the vesical portion of ureter there was marked narrowing. Above this the ureter had large calibre.

The attacks of right-sided renal colic were accounted for by the obstruction resulting from the very sharp angulation between the kidney pelvis and ureter. This angulation was probably more acute when patient was in upright position. An extremely short ureter made fixation of the kidney in a higher position impossible. The possibility of overcoming the obstruction at the ureteropelvic juncture by a plastic operation was considered but the small calibre of the ureter and low function of the kidney rendered such a procedure inadvisable. Nephrectomy was therefore advised. May 19, 1930, the patient was again admitted to the hospital and on the following day, under gas-ether anæsthesia, a right rectus incision was made extending from just above the symphysis to a little above the umbilicus into the peritoneal cavity. With the patient in Trendelenburg position, and after packing off the intestines, the right kidney was exposed lying in the hollow of the sacrum. The upper pole was overlying the promontory of sacrum and the inner border of the kidney extended a little to the

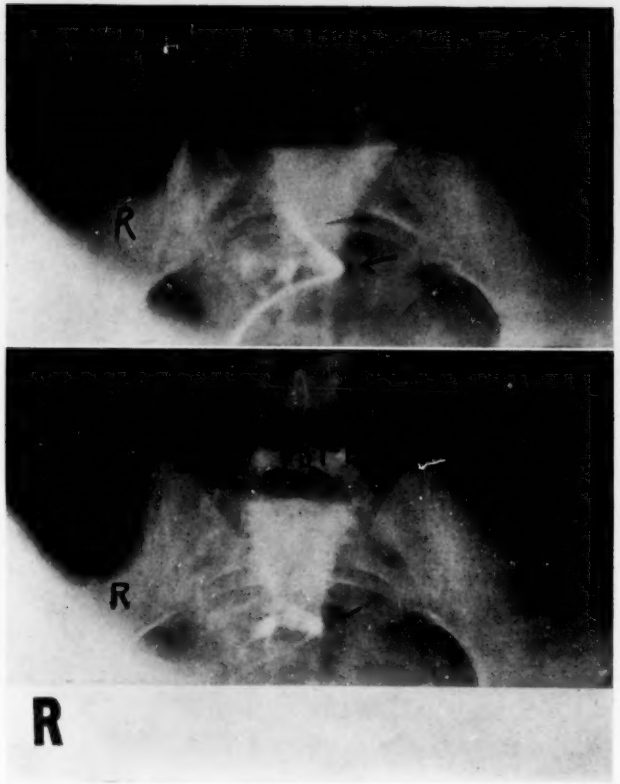


FIG. 1.—Right pyelo-ureterograms: 181-A with catheter tip in upper calyx, opposite promontory of sacrum. Note small size of pelvis and calices. 181-B: Catheter has been removed. Note small calibre of ureter and sharp angulation between pelvis and ureter.

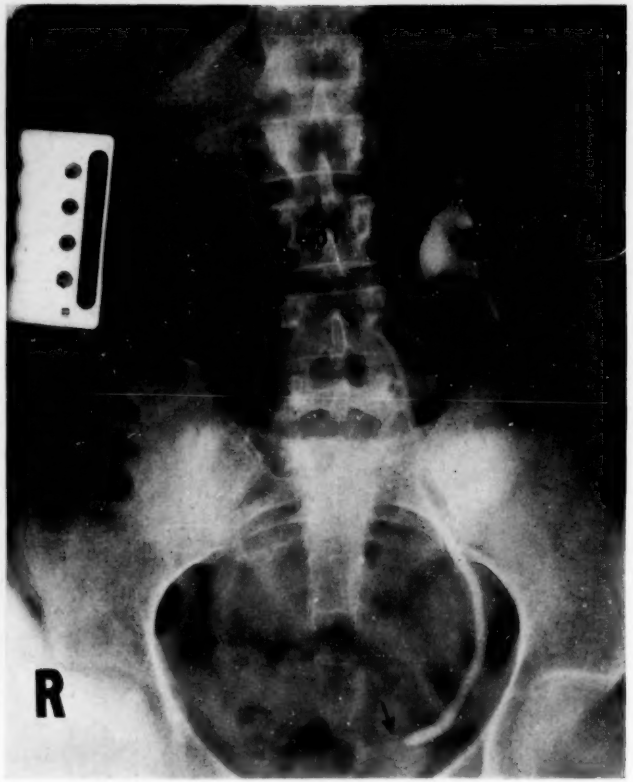


FIG. 2.—Left pyelo-ureterogram: Large kidney, ptosed; pelvis and calices moderately enlarged. Ureter is kinked opposite fourth lumbar vertebra. Stricture area is seen in lower pelvic portion of ureter.

left of the mid-line. It was noted that the uterus was unusually small and bicornuate. An ovary about the size and shape of a chestnut was found high in the pelvis on the right side. The right Fallopian tube was absent. The left ovary was in normal position and slightly larger than the right. The left Fallopian tube was abnormally long and tortuous.

The peritonæum overlying the kidney was opened transversely and the kidney was readily freed. There was no perirenal fat and a suprarenal body was not seen. One fairly large vessel was found entering the anterior upper portion of kidney. This vessel entered through a cleft separating an upper lobe of kidney from the main portion of the kidney. The chief vessels were found entering the kidney on its mesial and upper aspect. The arteries were derived from the right common iliac.

The ureter, which was of small size, was found inclosed in dense fibrous tissue. This fibrous tissue or fascia seemed to be pulling the ureter toward the left. After

FIG. 3.—Photograph of operative specimen—anterior view. Note the abnormal form of kidney and cleft separating an upper lobe from main portion.

removal of the kidney the posterior peritoneal incision was closed without drainage and the abdominal wall was closed in layers without drainage.

The patient made an uneventful recovery and she was discharged from the hospital June 4, 1930. She has been seen by me four times since then and reported that she was entirely relieved of pain in the abdomen.

*The Specimen.*—The kidney was much smaller than a normal organ. It measured 4 inches by 2¾ inches by 2 inches, weight 108 grams. The shape was abnormal; the lower portion was thicker and wider than the upper portion. On the anterior surface there was a deep cleft separating an upper lobe from the larger main portion of kidney. Near the upper pole on the posterior surface there was a depression to fit the sacrum. The pelvis was small and entirely intrarenal. Sections from the cortical area microscopically showed tubules lined with flattened cells. Fibrous tissue was more abundant than in normal kidney tissue.

*Comment.*—A number of interesting features were presented by this case. The history was rather typical of a patient with chronic renal stasis and attacks of renal colic. Dull pain in the right side of pelvis was clearly due to overdistention of the right kidney. Acute angulation of the poorly developed ureter produced more or less constant partial obstruction and the attacks of renal colic occurred whenever there was ureteral œdema to increase the obstruction. The increased size of the left kidney was interpreted as compensatory hypertrophy. As a result of a previous inflammatory process there was an infiltration area in left ureter, producing partial obstruction. The kink of left ureter was a result of ptosis and it was regarded as unimportant.

The anomalies of the organs of reproduction consisting of small poorly developed ovaries, absence of right Fallopian tube, infantile bicornuate uterus and abnormally short vagina, accounted for the irregular, scanty menstruation and the sterility. The record of the previous operation does not note the removal of right tube.

Ectopic kidney is to be clearly differentiated from the abnormally movable kidney which has ptosed into the pelvis. The chief characteristics of the ectopic kidney are (1) abnormally short ureter, (2) firm fixation of kidney, (3) blood-vessels derived from the regional vascular trunks.

Failure of the embryonic kidney to reach the usual position results in ectopic kidney. In 5-millimetre embryos the beginning kidney is found as a budding from the caudal end of the Wolffian duct in the sacral region. From this point the kidney grows in a cephalic direction and normally it reaches the permanent renal level opposite the second lumbar vertebra at about the end of the second month. Vascularization of the organ occurs after it has reached its permanent location. If some unknown factor interferes with the upward migration of the kidney it receives its blood supply from the regional vessels as lower aorta, common iliac, internal iliac. The blood-vessels then serve to fix the kidney in its abnormal site. According to Judd and Harrington[1] there is often an associated defective development of Mueller's duct which accounts for the frequent association of genital malformations, particularly in the female. Pelvic organs of the infantile type, absence of a tube or ovary and malformation of the vagina are common associated anomalies. Guizetti[2] states that anomalies of the genitalia can be found in one third of the cases of renal anomalies.

With the present-day extensive use of cystoscopic and X-ray examinations congenital anomalies are being reported with increasing frequency. Dorland[3] in 1911 collected 121 clinical cases of ectopic kidneys from the literature and about 100 had been published since 1898. Huffman[4] states that slight degrees of congenital displacements are not unusual but that marked degrees are rare. He quotes Guizetti and Pariset[5] who reviewed protocols of 20,000 autopsies and found eighteen cases. "Congenital misplacement of the kidney is found about once in 1000 bodies," is the frequency stated in Cabot's "Modern Urology."[6] Collings,[7] who recently reported a case, stated that his

case was the first recorded in the past twenty years in the record room of Bellevue Hospital. The reported cases indicated that the condition occurs with about equal frequency in the two sexes.

The ectopic kidney may be structurally and functionally normal. Such a kidney may never give rise to symptoms. Frequently, however, the kidney and ureter are malformed and thereby predisposed to disease. Strater[8] reported twelve cases of hydronephrosis and six cases of pyonephrosis in a total of twenty-seven collected cases. Pyelonephritis, calculus, tuberculosis and sarcoma have also been reported. The symptoms, of course, vary with the pathology. When there is ureteral blockage pain is felt in the sacroiliac region and lower abdomen. The pain may vary from mild aching to the severe colic type. Reflex phenomena, particularly gastro-intestinal disturbances and toxic symptoms, are produced when there is renal overdistention and stasis. Increased pelvic pressure incident to pregnancy may severely embarrass a pelvic kidney and if pregnancy goes on to term it is likely that the kidney will interfere with normal delivery and necessitate Cæsarian section.

An exact diagnosis can be made only by urography. The discovery of a mass in the pelvis by rectal or vaginal examination may suggest the diagnosis. Subjecting patients with abdominal symptoms that cannot be diagnosed by ordinary methods of physical and X-ray examination to cystoscopic study will frequently result in a correct diagnosis.

Pyelonephritis and calculus disease are treated by the same methods used for the conditions in normally situated kidneys. Operations that attempt to place the kidney in a more favorable position have been performed without beneficial results. If the ectopic kidney has little or no function and the pathology cannot be relieved by palliative measures nephrectomy is obviously indicated providing there is a healthy, normally functioning kidney on the other side. The pelvic kidney is easily approached by the transperitoneal route.

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# BENIGN TUMORS OF THE BLADDER

By Charles Clair Higgins, M.D.

of Cleveland, Ohio

from the cleveland clinic

Benign, non-papillary tumors of the bladder are of relatively rare occurrence. In a series of cases of benign tumors of the bladder cited by Koll in 1922 only thirty-eight were of this type. Since that time a comparatively small number of additional cases have been cited by Kostjurin, Stevens, McNally, Kidd, Smith and others. Because of the rarity of the condition, it would appear to be of value to offer the following case report, together with a brief review of the literature pertaining to this subject.

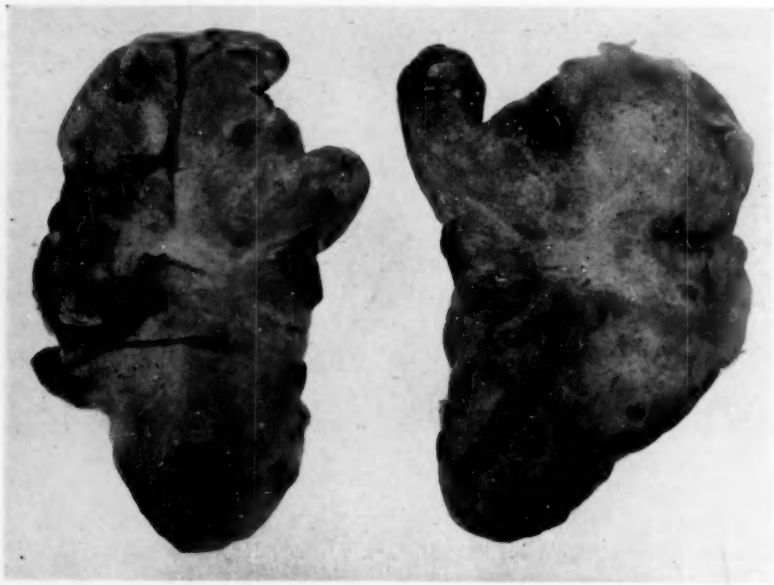


Fig. 1.—Fibromyxoma of the bladder—gross specimen.

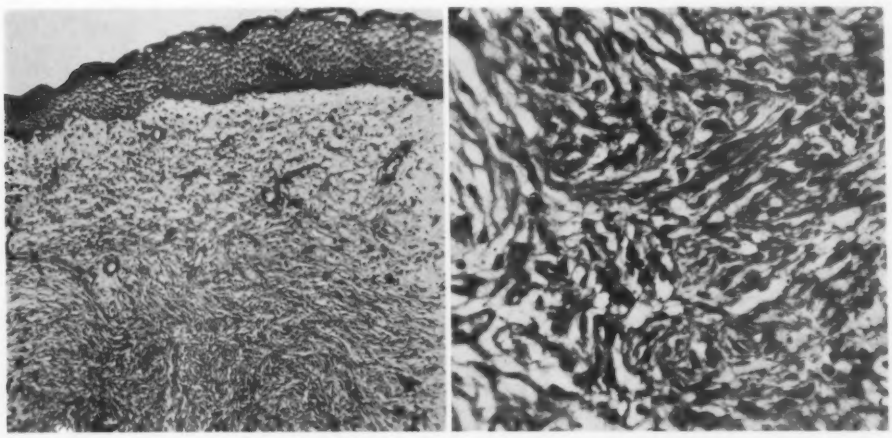
Case Report.—A man thirty-nine years of age, entered the Cleveland Clinic complaining of blood in the urine. This condition, which was first noticed two years previously, was accompanied by frequency, urgency, dysuria, and hæmaturia. These symptoms subsided and the patient had felt well until a few months before entering the clinic when he noticed large clots of blood in the urine. During the preceding three weeks blood had been present in the urine each time he voided. At the time the patient presented himself for examination he had nocturia three to five times, voided every hour during the day, and complained of urgency, urethral and vesical pain. He gave an indefinite history of having had bladder discomfort and hæmaturia thirteen years previously. The patient had had a chancre several years before, but otherwise his personal and family history were unimportant. Physical examination elicited definite suprapubic tenderness over the bladder. Laboratory findings were negative except for a four plus Wassermann and the presence of pus and blood in the urine. The cystoscope was passed with ease and 150 cubic centimetres of bloody urine were removed from the

bladder. Distention of the bladder was difficult on account of irritability. A large tumor with a definite pedicle was found above and lateral to the left ureteral orifice. There was no sloughing. Under spinal anæsthesia the tumor was excised. Convalescence was uneventful and eight months later the patient was free from symptoms.

The specimen consisted of a yellowish-gray tumor weighing thirty grams and measuring 5.5 by 4 by 3.5 centimetres. (Fig. 1.) It was irregular in outline, somewhat round, and had a thin, transparent capsule. On section it appeared to be quite cellular in some portions with a firm, fibrotic central portion leading to a pedicle which was one centimetre in diameter. Parts of the cut surface appeared to be mucoid in character.

Microscopic examination showed the tumor to be covered on the surface by bladder mucosa. The epithelium was of the epidermoid type except for a few gland-like structures below the level of the surface. (Fig. 2.) The rest of the tumor was loose and fibromyxomatous, with numerous small and large spaces showing granular material. There was no evidence of malignancy. The pathological diagnosis was fibromyxoma of the bladder.

*Review of Literature.*—The greater number of benign tumors of the



A B

FIG. 2.—Photomicrograph of section of fibromyxoma of the bladder. A—x 80. B—x 400.

bladder reported have contained smooth muscle tissue. In Koll's series, this element was present in thirty-four cases; four were cases of fibroma. Since 1922 Maingot, Latzko and Smith have added cases of fibroma, and a case of a fibroma which was successfully removed is cited in this paper.

*Classification.*—Benign, non-papillary tumors of the bladder may be classified as follows:

(1) Myoma: (*a*) fibromyoma; (*b*) leiomyoma; (*c*) rhabdomyoma. (2) Fibroma: (*a*) fibroma durum (hard fibroma); (*b*) fibroma molle (soft fibroma). (3) Angioma. (4) Myxoma.

*Histology.—Fibroma* arises in the bladder mucosa, and as it enlarges it grows out into the bladder. The *fibroma durum*, as its name implies, is hard, and on examination may or may not be found to be pedunculated. On microscopic examination the bundles of fibres are found to be very closely packed, and very few blood-vessels may be seen, these coursing in a direction parallel with the thick, fibrous bundles. The bundles of connective tissue

fibres vary in thickness, the cells appear to be diminished in number, and the nuclei are scarce. Koll states that *fibromata dura*, or hard tumors of the bladder, may undergo calcification and necrosis on account of their lack of blood supply. In the *fibromata molle*, or soft tumors, the bundles of fibres are more loosely arranged and the nuclei and cells are more abundant. The blood-vessels are more prominent and the tumors, therefore, are more vascular.

*Leiomyomata* are tumors composed chiefly of non-striated or smooth muscle and resemble tumors of the uterus. In the reported cases, leiomyomata have varied in size from that of a pea to that of an egg. They may be single or multiple. Grossly, these tumors consist of dense, firm nodules, which may or may not be pedunculated. The nodules are sharply demarcated from the bladder wall, their consistency depending upon the ratio of muscle elements to the connective tissue. As the tumor extends into the bladder, the nodules carry over them a thin layer of bladder mucosa. Microscopical examination shows these tumors to consist of smooth muscle fibres arranged in interlacing bundles. The stroma consists of connective tissue through which the blood-vessels course.

*Rhabdomyomata* are tumors containing striated muscle, and histologically they are more complex than are other tumors of the bladder. MacCallum cites a case (reported by C. Cones) of a rhabdomyoma in a child, beginning in the vaginal wall and extending into the bladder. These tumors are usually polypoid in character, may be single or multiple, and vary in size from a pea to a large polypus. Microscopical examination shows these tumors to be œdematous, showing small, spindle-shaped cells, among which are scattered larger cells with striated protoplasm. These larger cells are narrow, having a central space which contains many nuclei. The striations are both longitudinal and transverse.

*Angioma* in the bladder resembles angioma found elsewhere in the body. Kelly reports one doubtful case which was observed in 1851. Albarran, in 1892, cited one case of angioma which was found post mortem, another case is cited by R. C. Bryan, and another case has recently been cited by Hamer. O'Crowley and Martland believe that most tumors of the bladder in adults which are described as *myxomyomata* in reality are œdematous fibroblastomata or papillomata with œdema.

*Age Incidence.*—In Koll's collected series of cases of benign tumors of the bladder, one case occurred in the first decade, one in the second decade, nine in the third, five in the fourth, ten in the fifth, five in the sixth, one in the seventh, and two in the eighth decades. The youngest patient reported in the literature (by Sims) was a girl three years of age, with myxofibroma; the oldest was seventy-four years of age. Belfield reports a case of a patient in whom autopsy revealed a myoma of the bladder, and Nauman reports a case of fibromyoma. Very few cases in children are reported because the growth of the tumor is slow, and there may be no symptoms referable to it. This likewise explains the coincidental findings of such tumors at post-mortem examination.

*Etiology.*—The etiology of benign tumors of the bladder is vague. Verhoogen believes they are formed by the development of the partially atrophied Müllerian body. Blume suggests that they may originate from the hypertrophied Müllerian body secondary to a prolonged inflammation. Heger believes they may develop from the hydatid of Morgagni or the lower layer of the utricle. Blume's theory is the most plausible, perhaps, in view of the number of myomata which have been reported. The theories of Verhoogen and Heger do not explain the occurrence of fibroma or angioma. Faye reports a case of fibromyoma found at autopsy in which the tumor was as large as a man's head. Kostjurin cites a case, reported by Kresnetzki, of a myoma which weighed 9,200 grams, and Polaillon cites the case of a fibromyoma weighing 3,200 grams. Riegel reported a case of a myoma which filled the entire bladder. However, the tumors most frequently observed vary in size from that of a pea to several grams in weight.

In most of the cases reported, the tumor has arisen in the region of the ureteral orifice or the trigone, although no part of the bladder is exempt. In a few of the cases cited, the pedicle of the tumor was attached to the vertex of the bladder, and cases of tumors arising from the posterior and lateral walls of the bladder have been reported.

Kidd draws attention to the fact that in benign, non-papillary tumors of the bladder, the main blood-vessels course between the mucosa of the bladder and the tumor, and do not pass directly into the body of the tumor. In this respect they differ from papillomatous tumors of the bladder.

*Symptomatology.*—As a rule, benign tumors of the bladder present no symptoms until they reach a considerable size. For this reason, frequently they are not discovered except at post mortem examination. However, if the tumors have a long pedicle, or if they are near the vesical neck of the bladder, obstructive symptoms may occur which will attract attention to the fact that some pathological condition of the bladder is present. Or the tumor may be in such a position as to cause ureteral obstruction, with subsequent hydronephrosis.

In Koll's cases frequency was present, but not until after the tumor had grown to a considerable size. In one case urinary obstruction was caused by a small, pedunculated tumor; in another, pain over the kidney warranted a complete urological examination which revealed a large tumor which encroached on the ureteral orifice and had produced hydronephrosis. In the case cited in this paper there had been intermittent attacks of hæmaturia with slight irritability of the bladder, for two years.

*Diagnosis.*—The diagnosis of a benign tumor of the bladder can be established by the use of the cystoscope, although in the case of a very large tumor, visualization is difficult, and for this reason prior to operation these tumors are often diagnosed as malignant. In the case of large tumors, the capacity of the bladder is markedly diminished. The cystoscopic appearance of a small tumor is quite different from that of a papilloma or malignant tumor. As a rule, bleeding is not marked, the bladder is less irritable, and the tumor is smooth and glistening. There is, usually, no sloughing, and

touching the tumor with a ureteral catheter does not cause as much bleeding as would be the case if the tumor were malignant.

*Treatment.*—Excision of the tumor is the procedure of choice, a wide excision being made to assure complete removal in case an unsuspected malignant transformation may be present, for although, grossly, the tumor may appear to be benign, miscroscopic examination may reveal a malignant condition. Recently I saw a case in which a fibromyoma had become malignant.

*Prognosis.*—Removal of the tumor assures a complete cure and an entire cessation of symptoms.

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# LITHOLAPAXY—THE METHOD OF PREFERENCE FOR THE REMOVAL OF VESICAL CALCULI*

By John Roberts Caulk, M.D.

of Saint Louis, Mo.

FROM THE GENITO-URINARY CLINIC OF WASHINGTON UNIVERSITY

It is my purpose in this paper to discuss the advantages and disadvantages of the suprapubic removal of stone from the bladder as compared with the crushing operation and evacuation of fragments commonly known as litholapaxy. These two operations alone will be considered since perineal section for stone is seldom employed in the present day unless as part of a perineal prostatectomy.

The incidence of vesical calculus varies in different countries and climates and its proportionate frequency to calculous disease has undergone a radical change with the institution of the thorough urological investigation. For instance, in the early days, before thorough urological and radiological study, stones in the bladder were entirely out of proportion to the number of renal or ureteral stones; Thomson, in India, reported 2962 cases of vesical calculi and only five renal. Joly reports 371 cases of stone in the bladder out of 636 patients admitted to St. Peter's Hospital between the years 1915 and 1924, approximately 50 per cent. of all stone cases admitted to that hospital. In our clinic the proportion between kidney and ureter stones and bladder stones on admission is almost 3 to 1.

The current conception in the treatment of stone in the bladder is that litholapaxy is indicated in all simple stones, that is those without obstruction, without the association of diverticulum, bladder tumor, intense cystitis or urethral stricture, and that surgical removal is always the operation of choice for the complicated stones. Indeed, in the hands of the average surgeon, I am inclined to think that suprapubic cystotomy is more frequently performed even for the simple stone cases. The reason is that litholapaxy is considered a special operation and one to be utilized only by those expert in the manipulation of instruments. From the patient's standpoint, such a practice is not justified and in this paper I will attempt to substantiate the assertion, namely, that litholapaxy, when properly performed, is applicable not only for simple stones but also in a goodly number of stones complicated by other conditions.

Of 225 cases of vesical calculi, the average age was 56.6 years. The frequency according to decades: 1–10, 7 cases; 11–20, 5 cases; 21–30, 11 cases; 31–40, 15 cases; 41–50, 28 cases; 51–60, 43 cases; 61–70, 69 cases; 71–80, 33 cases; 81–90, 6 cases; total of 217 cases in which the age was given. It might be of interest to note that the majority of stones in the bladder occurred between the ages of 40 and 70; the most frequent number

* Read before the Southern Surgical Association, December 10, 1930.

occurring between 60 and 70, *i.e.*, the age of vesical neck obstruction. There were 197 males or 87.5 per cent. and 28 females, or 12.5 per cent. There were 205 whites, 91.1 per cent. and 20 colored, 8.9 per cent.

A history of previous passage or removal of stone was elicited in forty-five patients or 20 per cent. of the total number. A history of previous renal colics was given by 15.5 per cent., although 60 per cent. of these had not, as far as they were aware of, passed a stone. It was found on admission that 9.4 per cent. of patients with stone in the bladder had associated kidney or ureteral stones but only about half had either previous history of colic, passed a stone, or had a previous operation. In short, about 25 per cent. of the patients had an association either through history or actual finding of upper urinary tract calculus.

In the cases of vesical calculi reviewed there was associated prostatic enlargement in 116 cases, or 51.4 per cent., including twenty carcinomas of the prostate, or 17 per cent.

Stricture of the urethra occurred in seventeen cases, or 7.5 per cent.; of these seven were associated with prostatic hypertrophy.

Other conditions associated with stone were: cancer of bladder, 13; diverticula of bladder, 17; neurogenic bladder, 5; suprapubic fistula, 8; vesicovaginal fistula, 1; recto-urethral fistula, 1; perineal fistula, 2.

In other words, obstruction was present in 55.8 per cent. of all cases. In this obstructive group eighty-eight, or 70 per cent. had given no previous history of stone, such as colics, or passage of calculi, and the X-rays of renal areas were negative on admission; these were obviously cases resulting from obstruction. Thirty-eight cases or 30 per cent. had previous history of colics or calculi.

In the group of non-obstructive cases 55 per cent. gave history either of previous passage of stones, colics, or had stones on admission. Fifty per cent. were associated with cystitis, of which over half were of the incrusted type; whether this is the result or the cause is difficult to determine.

There were eight foreign bodies encountered: one wax-ball, one surgeon's needle, one hairpin, one rubber tissue, two incrusted sutures, two incrusted catheter tips. Only two of the foreign bodies were subjected to open surgery; the wax-ball and the hairpin stones, the others having been extracted endovesically.

Out of the total group of cases 65 per cent. were regarded as good risks and 35 per cent. were poor. Of the poor risks forty-two or 60 per cent. were operated upon by litholapaxy with one death, or 2.4 per cent., sixteen were attacked suprapubically with four deaths, 25 per cent. twelve of the cases were not subjected to surgery due to severe associated conditions such as bad myocardial lesions, pneumonia and central nerve lesions; of these 75 per cent. died during their stay in the hospital without having been subjected to operation.

Of the total number of cases of stone there were 196 operations. In twenty-nine cases no operations were performed, either because they were

extremely bad risks or refused operation. In 112 of the 196 surgical cases litholapaxy was done, or 57.0 per cent.; in thirty-two suprapubic cystotomy alone was done; in fifty-two cystotomy was performed in conjunction with prostatectomy and other surgical procedures such as diverticulectomy, bladder resections for tumor, radium implantation or cauterization. Litholapaxy was performed in forty-four cases in which there was an associated prostatic hypertrophy, seven were done in cases with prostatic carcinoma and eight with strictures of the urethra. In all, over 52 per cent. of the litholopaxies were done in obstructive cases. In sixteen of the obstructive cases in which litholapaxy was performed the cautery punch at a later date relieved the obstruction completely. The association of litholapaxy and minor surgical removal of obstructive conditions at the orifice employing the cautery punch has, in my mind, an increasing field of usefulness. One is apt to misinterpret the extent of prostatic overgrowth in the presence of stone; indeed it is commonly done without such association. Catheter drainage will oftentimes transform the orifice picture so that repeated cystoscopic and rectal examinations prove that the obstructive condition is sufficiently small to be treated without resorting to open surgery.

In the case of stone there is often considerable œdema and reaction around the orifice which rapidly subsides after litholapaxy. It is then found that in many cases no surgical attention to the obstruction is necessary. The same is also true of carcinoma of the prostate in which case the reaction around the carcinoma will frequently disappear under drainage following litholapaxy. I believe that whenever possible one should always shun open surgical attack upon a carcinomatous prostate. The combination of radium implantation and deep X-ray therapy and the punch operation afford much better results than open surgery. In my hands it is rare for the carcinomatous urethra to prohibit litholapaxy.

There have been forty litholapaxies performed on patients who had had previous prostatectomy. In some of these there was evidence of obstruction, others were recurrent stones, in all probability secondary to infection.

It is usually conceded that the presence of a vesical diverticulum contraindicates any attempt at crushing operation for stone. As a general rule, this is perfectly true. Occasionally such complications, however, occur in very bad risks, usually in older subjects on whom resection of a diverticulum plus prostatic enucleation and the removal of the stone, whether in one or two stages, would be a hazardous procedure and an operation of such magnitude as to be almost prohibitive from the standpoint of safety. In such cases, if the stone be troublesome, it may be crushed and the obstruction relieved by simpler transurethral measures. In the seventeen cases of diverticula which have occurred in this series, six were treated by litholapaxy either alone or with the cautery punch operation with no mortality. Nine resections of the diverticulum were performed with prostatectomy later, with one death, or 11 per cent. mortality. In two cases no operation was performed, one had an aneurism, the other pneumonia.

I am perfectly willing, in a bad risk and even in some fairly good risks, providing the diverticulum is not too large and is draining fairly well, to be content with the relief of obstruction at the orifice and the crushing of the stone. Occasionally, the penalty of such conservative procedure may be that fragments will fall into the diverticulum and there produce larger stones.

Of the thirteen carcinomas of the bladder in this series, eight were not associated with obstruction, whereas the other five were. Litholapaxy was performed in five instances; small stones were removed with the cystoscopic rongeur in two others. Carcinoma of the bladder is regarded as an absolute contraindication to litholapaxy; most surgeons agree that the bladder should be exposed and the carcinoma treated by open operation of one type or another. I am, however, strongly opposed to open bladder surgery in the treatment of most cases of bladder carcinoma. After a lengthy experience with this type of surgery I have abandoned it and have been more than gratified with the results obtained by repeated radium implantations and diathermy through the cystoscope in association with deep X-ray therapy.

The crushing of the stone in the presence of carcinoma does not appear to present any extreme hazard. After being seized, the stone is crushed, not on the bladder wall, but in its cavity. On the contrary, the danger of rupture should be very slight and the danger of spread of the tumor should be much less than that occasioned by open surgery.

There were twenty-seven cases of intense severe cystitis in this series, another supposed contraindication to litholapaxy. This fact is mentioned in order to make impressive what can be accomplished by adequate preoperative drainage and the proper anæsthesia. Bladder irritability and contracture are minimized and with twilight and caudal anæsthesia I have experienced no trouble with this complication. Fifteen of these twenty-seven cases were operated upon by litholapaxy after catheter drainage and preparation without mortality or serious complications. Indeed, intense cystitis is much less to be feared than a less severe pyelonephritis.

There is no doubt that litholapaxy is the ideal procedure for simple uncomplicated stones in the bladder. The simplicity of the operation without general anæsthesia, its freedom from complications with consequent short hospitalization, often amounting to only one or two days, and freedom from economic loss stamp this operation unquestionably as the one of choice in this type of stone. I am thoroughly convinced, however, that it has also an ever-increasing field of usefulness in the complicated cases and should be more frequently employed. In a great measure the same complimentary remarks may be directed here as in the simple stones.

Concerning the size and multiplicity of calculi, with reference to their suitability to litholapaxy, I have records of 169 cases in this series where the size and number of stones were mentioned. Of these sixty-six were multiple, or 39 per cent., of which 60 per cent. were cured by litholapaxy; fourteen, or 35 per cent., requiring multiple-stage operations. There were

eighty-two large stones either alone or associated with smaller ones. Twenty-seven of these were cured by litholapaxy, or 33 per cent. Of these, eight cases were done in multiple stages, or 29.6 per cent. Multiple operations were performed in the entire group in one-third of the cases. In the small stones litholapaxy was performed in multiple stages in 35.4 per cent. It is thus seen that the size of the stone or the multiplicity does not necessarily influence the number of operations required to effect a cure. Other things, such as the patient's tolerance, the character of the stone, associated lesions in the bladder, kidney and urethra enter into the picture.

One of the most difficult stones to crush was a small stone no larger than a cherry. It proved to be a xanthine stone, the only one in the series. The size of the stone, *per se*, within certain reasonable limits, offers no contraindication to stone crushing. Very often the larger the stone the softer and the easier it is to crush. Some of the largest stones have been the easiest to cure by litholapaxy.

In one case the patient had had a suprapubic prostatectomy for carcinoma a year prior. We found he had a very close stricture of the urethra and there was great difficulty in passing a filiform, but it was finally dilated to a No. 20 French. The stone in his bladder which was detected by X-ray was over 2 inches in diameter. After repeated attempts at dilatation of the urethra it was found impossible to dilate it sufficiently to investigate the bladder cystoscopically or to attempt any other urethral manipulations. When a low spinal anæsthesia was given there followed a most striking relaxation of the urethra, so that in spite of his carcinoma, a lithotrite was easily inserted and the large stone was crushed in one sitting. I am positive nothing short of spinal anæsthesia could have produced sufficient relaxation to have permitted litholapaxy. This patient had previously been given general and caudal anæsthesia in an attempt to dilate the urethra.

This suggests a possible contraindication to litholapaxy, namely, bladder contracture and stricture of the urethra. One is often misled in the interpretation of the amount of contracture, both in urethra and bladder, by muscle spasm. The relaxation produced by means of caudal or spinal anæsthesia enables the true capacity to be determined and many patients may be spared a major operation who would otherwise have been subjected to it. Contracture of the bladder, often regarded as a contraindication to litholapaxy, is in a great majority of instances physiological. True contracture seldom exists except in tuberculosis and carcinoma of bladder and occasionally in calculi associated with general vesical wall infiltration, and pericystitis.

As to the technic of litholapaxy. In the first place, proper anæsthesia is essential. In many of the simple cases local urethral anæsthetic is all that is necessary. The majority, however, do much better under caudal and twilight. There appears to be no necessity for a general anæsthetic.

In certain rare cases spinal is the ideal anæsthetic. The chief structures to be protected during this operation are the urethra and bladder wall. It is essential to crush as much as possible during one introduction of the

lithotrite and then remove it for evacuation. It is seldom necessary to insert the lithotrite more than twice at one sitting. There is one procedure which is very important in protecting the urethra from tears or injury resulting from fragments adhering to the instrument. Before it is withdrawn it is advanced into the bladder and when it is centred in the open bladder, the male and female blades are jammed together in order to throw off the impacted fragments and then screwed together tightly before extraction.

I much prefer to do repeated litholapaxies, possibly a week apart, than to do too much at one sitting.

The bladder should suffer very little trauma as one should always depress the jaws of the lithotrite toward the base of the bladder and after opening and grasping the calculus they are firmly locked and centred in the open bladder away from the wall before crushing is commenced. Employing this technic it is very often possible to crush a stone of considerable size with very little bleeding.

In very large stones, even those that are too large to be completely grasped by the instrument, I have found it advantageous to crack the outer coating, grasping them laterally. On several occasions I have done this without evacuation and by changing the chemistry of the urine by injections of bulgara bacillus, the stone readily passed into solution and disappeared, or had undergone spontaneous fragmentation making litholapaxy a simple procedure for the removal of the remaining fragments.

It is my custom always to follow litholapaxy by instillations of bulgar bacilli with very gratifying results. On several occasions I have observed the bladder cystoscopically after crushing and found numerous fragments in the bladder and a week later have found the bladder entirely clean. This is particularly true in the phosphatic stones. Where repeated crushings are required an indwelling catheter is employed and careful attention given to the bladder.

History shows that the first lithotroties were done in multiple stages on account of fear. Recently an endeavor has been made to do the operation in one stage, usually under general anæsthesia. I feel that the repeated operation on difficult stones, whether large or small, or multiple, is far preferable to a long-continued operation under anæsthesia and to the excessive trauma from repeated instrumentations. One usually has to wait four or five days to a week between operations until the reaction from the first is over.

I have seen only one serious complication following multiple-stage litholapaxy and this resulted from the patient's lack of coöperation and was not the result of the operation itself. Four days after a simple litholapaxy, the patient left the hospital, under protest, with an indwelling catheter. He promised to return in a few days, but did not return for ten days. In the meantime he removed his catheter, was able to void without difficulty for the next twenty-four hours and then suddenly had retention due to a frag-

ment which became impacted in the urethra at the peno-scrotal juncture. He was finally able to urinate but did not pass the fragment. About a week later he appeared with a large peri-urethral abscess at the root of the penis on the dorsum. It ruptured spontaneously and a spicule of stone was projecting from the dorsum of the penis. This left a large, fistulous opening which persisted for sometime, but when I last saw him it had practically cleared. The remaining fragments were later crushed and the bladder entirely healed. This complication would not have happened if the patient had been under supervision. It is always essential to cystoscope the patient after litholapaxy before discharge to be sure that all fragments have been removed.

There have been but very few complications from litholapaxy in these cases: pyelonephritis, 4.4 per cent.; epididymitis, 4.4 per cent.; hæmorrhage, once; peri-urethral abscess, 3 per cent.; impacted calculus of urethra, 3 per cent.

The average duration in the hospital in 112 cases of litholapaxy has been ten days. Most of the simple stone cases were out in two or three days. Hospitalization was lengthened by the complicated cases which really remained in for the treatment of the complications, such as hypertrophy, tumor and infection.

The indications for the suprapubic operation are large stones, stones which are adherent to the bladder wall and those associated with other pathological conditions, such as prostatic obstruction, stricture, diverticulum, or tumor. The average stay in the hospital from suprapubic cystotomy has been thirty-nine days.

The mortality from simple cystotomy in thirty-two cases was one death, 3.1 per cent. In the fifty-two cystotomies for stone in which prostatectomy or prostatectomy with resection of the bladder for tumor or for diverticulum was done, there were seven deaths, or 13.4 per cent. In this group four deaths followed bladder-wall resection along with prostatectomy and stone removal. Disregarding these, the mortality from prostatectomy and stone has been 6.2 per cent. This has occurred in the face of the most accurate care in preparation, anæsthesia, surgery and treatment. However, it follows the trend of general mortality rate throughout the world; for instance, in St. Peter's Hospital, London, from 1915 to 1924, the mortality rate from suprapubic cystotomy was 9 per cent. according to Joly, and Freyer reported 14.6 per cent. in 116 cases of suprapubic lithotomy. Watson showed 13.2 per cent. in combined statistics of over 3000 suprapubic lithotomies. It is thus evident that the mortality rate following this operation is exceedingly high.

Of the 112 cases of litholapaxy there was one death, or 8/10 of 1 per cent. This individual was a bad risk; he was uræmic, had severe myocardial change, reacted badly from instrumentation, developed epididymitis, abscess of the testicle, septicæmia and died.

St. Peter's Hospital for stone mortality, litholapaxy, 226 cases—2.2 per cent.
Freyer Hospital for stone mortality, litholapaxy, 986 cases—2.5 per cent.
Watson and Cunningham Hospital for stone mortality, litholapaxy, 17,736 cases—2.4 per cent.

It thus seems that the average mortality in litholapaxies is around 2 per cent.

The data with reference to comparative recurrence of stone from the two operations are not sufficient to draw definite conclusions. I have been able to follow a large proportion of litholapaxies and find recurrence in 7 per cent. of cases. The returns on the open surgery were so few in number that no definite information can be furnished. There were forty patients in the group of litholapaxies who had had previous suprapubic or perineal operations. It does appear definite that recurrences following litholapaxies are less frequent than with cystotomy.

In conclusion it may be stated that:

1. Litholapaxy appears to be the operation of choice in the majority of stones in the bladder regardless of size or multiplicity.

2. The stone, *per se*, seldom contraindicates its operation and when associated with other conditions such as obstruction, tumor, diverticulum or active cystitis, it may lend itself to litholapaxy in a very definite percentage of cases.

3. It is strikingly free from complications and its mortality rate is relatively insignificant.

4. Compared to open surgery, the results gauged by the frequency of recurrence seem to be superior.

5. In this day of demand for efficiency with minimum sacrifice of time in point of economic loss occasioned by lengthy hospitalization following operation, litholapaxy offers a ready avenue of escape.

# ANALYSIS OF SEVEN HUNDRED CONSECUTIVE APPENDECTOMIES

By Leslie W. Tasche, M.D., and Joseph P. Spano, M.D.
of Minneapolis, Minn.

From the Department of Surgery of the University of Minnesota.

Thousands of articles have been written on the subject of appendicitis, and all phases have been studiously covered. Further studies, however, should be made as the incidence of appendicitis seems to be increasing, and the mortality rate does not show any noticeable improvement. Appendicitis is steadily increasing in frequency. The rate has advanced from 11 per 100,000 in 1920, to 14.4 per 100,000 in 1925; according to a governmental report on vital statistics, 20,000 people in the United States die annually from appendicitis.

The following report is based on the records of 700 consecutive cases of appendicitis operated upon at the University Hospital from January 1, 1920, to January 15, 1929.

*Sex*—There was an almost equal distribution of cases between the sexes: 354, or 50.5 per cent., were males, and 346, or 49.5 per cent., were females. There seems to be an increased incidence in males over females especially when large series of cases are studied. Those that show a majority on the female side usually deal with a larger number of the so-called chronic cases and also often include appendices that have been removed during gynecological operations.

When the cases are divided into the acute and into the chronic or interval groups, we find that there are 60.9 per cent. males and only 39.1 per cent. females in the acute group. The exact reverse is true in the chronic or interval cases with 61.4 per cent. females and 38.6 per cent. males.

*Age*—Acute appendicitis is primarily a disease of adolescent and early adult life. Exactly 75 per cent. of the cases developed during the second and third decades. (See Fig. 1.) Barkley found a majority of cases to fall between the ages of fourteen and forty-five. Bar found 65 per cent. between eleven and thirty; Richardson, 50 per cent. between fourteen and forty-five; Seifert, 67 per cent. between eleven and thirty; and Denk and Hoffman report the peak incidence during the second and third decades.

The average age was 21.9 years. This is somewhat lower than MacCarty's figures of 23.5 years and Burgess' of 26.3 years.

*Seasonal incidence*—The highest incidence of appendicitis is found during the summer season. Why this should be true is difficult to explain. Possibly it is due to the increased prevalence of gastro-intestinal disorders at this time of the year.

*Previous infections.*—Forty-one, or 5.8 per cent., of all the cases gave

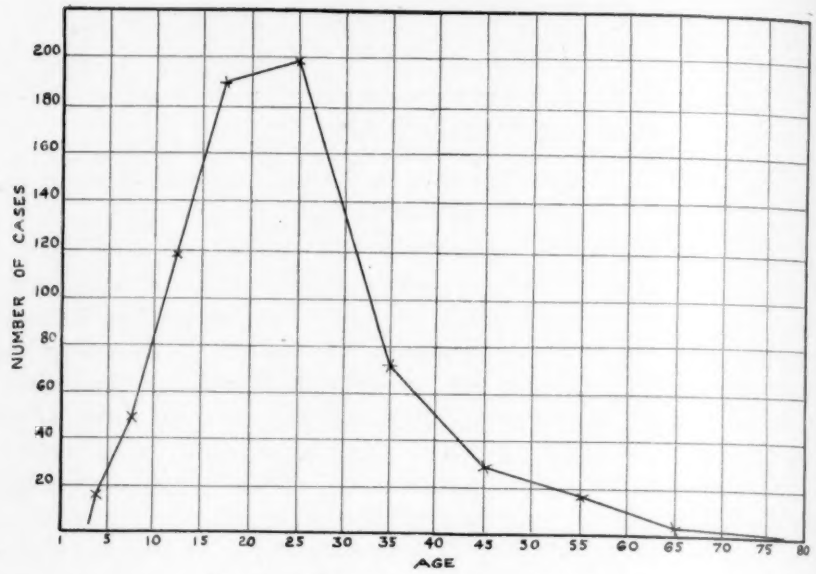


FIG. 1.—Distribution of cases according to age.

a definite history of recent infection, the most common of which were severe colds, sore throats, and tonsillitis. There were also two cases of measles, one of mumps, one of whooping cough, and one of scarlet fever. The presence of recent or simultaneous infection was found to be most prevalent among children, that is, in 31 per cent. of the cases. Brennemann found sore throats present in 17 per cent. of the children he operated upon for acute appendicitis, while Richter reported 4.0 per cent. in 172 cases. Evans stated that among the students at the University of Wisconsin acute appendicitis came in epidemics and that 86 per cent. showed "demonstrable primary upper respiratory tract infection."

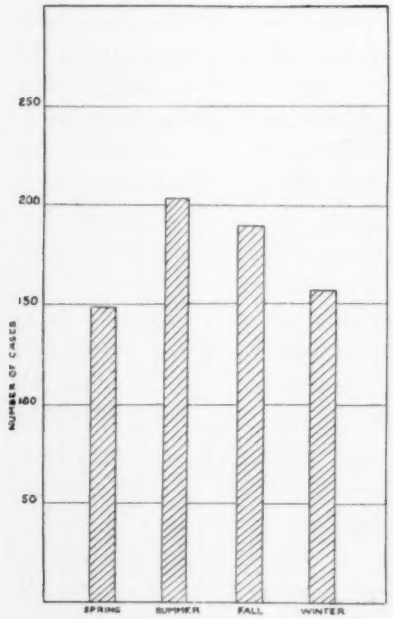


FIG. 2.—Distribution of cases according to seasons.

It is exceedingly difficult at times, but very important, to differentiate between the abdominal symptoms due only to severe upper respiratory or pulmonary infection and those due to an acute appendicitis accompanied by such an infection.

*Previous attacks.*—More than one-half, or 57.1 per cent., of the patients gave a definite history of one or more previous attacks; 8.8 per cent. gave a negative history, while on 35 per cent. of the records no mention of the matter

was made. This high figure is due partly to the fact that a great many of our patients were sent into the hospital as interval cases. Dowden reports 37 per cent. previous attacks; Carson, 35 per cent.; Isaacs, 30 per cent.; Burgess, 28.4 per cent.; and Backman, only 25 per cent.

*Classification of cases.*—An attempt has been made to classify the cases into separate clinical, surgical, and pathological groups. This was quite difficult to do and far from satisfactory in all instances. The purpose in mind was to see if one could predict correctly the surgical and pathological findings from clinical and laboratory information.

*Clinical groupings.*—1. *Mild.*—In this group were included those patients who complained of abdominal pain, usually located in the right lower quadrant, with loss of appetite and some nausea. The abdominal findings included tenderness over or near McBurney's point with very little or no muscle spasm on palpation over this region.

2. *Moderate or severe.*—These people complained of more pain with flexion protection of the abdomen, of anorexia, and of nausea or vomiting. There was usually marked tenderness present both on abdominal and rectal examination, with rigidity of the muscles and often rebound tenderness. The latter sign is almost conclusive proof of peritoneal involvement.

3. *Very severe.*—This division included those cases considered practically moribund with cold, clammy skin, anxious facies, dehydration, fecal vomiting, distention, and other signs of peritonitis and impending death.

*Pathological groupings.*—Every appendix removed at the University Hospital is examined grossly and microscopically by the pathologist. Unfortunately, eighteen of the pathological records have not been completed or have been lost. In eight cases the appendix was not removed. In 682 cases, the findings recorded permit of the following evaluation:

1. No evidence of active inflammation.

2. Acute recurrent appendicitis with previous infection evidenced by the presence of perivascular collections of lymphocytes in the serosa.

3. Acute suppurative appendicitis.

4. The so-called "obliterative" appendix.

The most satisfactory classification was found to be the surgical-pathological. The cases were grouped into five classes and each will be discussed separately.

1. *Chronic appendicitis.*—In this group were included all cases that came into the hospital with a definite history of previous attacks of appendicitis. Among them were many cases which should be classified as subacute or as acute subsiding appendicitis, since on admission to the hospital they showed definite tenderness over McBurney's point. There were also included a few cases that did not give a good history for recurrent appendicitis, but nevertheless were operated upon after all other possible lesions and especially kidney colic or pelvic infection had been ruled out by careful examination. Such operations were performed because these patients were sent to us by their doctors with the diagnosis of acute appendicitis, and we felt that we were not

justified to send them back into the country without considering the diagno submitted, especially as the doctors had usually seen the patients duri attacks.

There were 339 so-called interval cases. This number, in proportion t the entire series, is large. Fully 90 per cent. of our patients come from rur communities and often from the very "back-woods" itself. As a result man cannot be moved at the time of their primary attack and are sent in lat after the inflammation has subsided. There was one death in this series, a mortality of 0.3 per cent. The average leucocyte count was low, 8,000, wit an average polymorphonuclear count of 67 per cen Seventy-seven per cen of the cases, or 257, gave a definite history of one or more previous attack usually mild in character. Out of 321 specimens reported, 61 per cent., o 203, showed no sign of any inflammation present; 32 per cent., or 104, showe signs of recent inflammation; 3 per cent., or 11, showed an obliteration o the lumen of the appendix, and 3 per cent., or 9, showed actual suppuratio The mortality rate of 0.3 per cent. fits well with other reports. It should b 0 per cent., however, and any death must be attributed to a slip in techni at some stage during the operative procedure or to some unusual complicatio The cause of death in this case was probably due to a long exploratory pro cedure in a very obese middle-aged individual. The appendix was finall found under the liver attached to a cæcum which had not descended normall The patient died as a result of a severe paralytic ileus.

*Acute appendicitis.*—There were 361 cases of acute appendicitis. Thi does not include many so-called subacute cases which have been placed wit the interval group. The mortality rate for the acute cases was 6.4 per cen Very few statistics could be found that definitely separated the acute case from the others when giving mortality rates.

2. *Acute suppurative appendicitis.*—There were seventy-two cases in thi group. Included are all cases of suppuration of the appendix where ther was no peritoneal involvement or abscess formation. There was one deat with a mortality of 1.4 per cent. The average leucocyte count was 13,60 with an average polymorphonuclear count of 78.3 per cent. Two-thirds o the cases were classified clinically as moderately severe and one-third as mil Sixty-five per cent., or 47 specimens, showed suppuration microscopically i all of the coats of the appendix, while in 28 per cent., or 20, there were sign of inflammation present only in the serosal portion; in five cases there was n record of the pathologist's findings, but the gross description by the surgeo of the appendix in each case definitely placed it in this group.

3. *Acute appendicitis with local peritonitis.*—In this group were 156 case with four deaths, or a 2.5 per cent. mortality. The average leucocyte coun was 14,800 with an average polymorphonuclear count of 87.4 per cen Eighty-four per cent. of the cases gave a history of moderately severe symp toms with corresponding physical findings; the remainder were mild. Micro scopic examination revealed suppuration in 87 per cent. of the cases examine

and acute recurrent appendicitis in 13 per cent. In one case there was no report found.

4. *Acute appendicitis with abscess.*—In this group were included all cases of suppurative appendicitis with abscess formation. Out of 112 cases there were eleven deaths, or a mortality of 9.7 per cent. Eighty-four of the abscesses were localized to the immediate neighborhood of the involved appendix; while in twenty-nine the collections of pus were elsewhere—four in the subphrenic region and the remainder in the flank or pelvis. The average leucocyte count for the entire group was 18,000 with an average polymorphonuclear count of 80.1 per cent. Nearly all, or 87 per cent., had moderate or severe symptoms and findings. The pathological report on 92 per cent. of the cases showed suppuration. Two per cent. showed acute recurrent appendicitis; in seven cases the abscess was drained without removing the appendix.

5. *Acute appendicitis with diffuse peritonitis.*—This group included all cases of suppurative appendicitis with diffuse peritonitis usually of streptococcic origin. There were twenty-one cases with eight deaths, or a mortality of 38.0 per cent. The average leucocyte count was 19,000 with an average polymorphonuclear count of 84.3 per cent. All of the cases were classified as having had moderate or severe symptoms and findings. Four cases were practically moribund when they arrived at the hospital. All of the appendices removed showed suppuration when examined under the miscroscope. In one case the appendix was not removed, although the peritoneal cavity was drained.

TABLE I summarizes the pathological findings according to surgical groupings.

TABLE I

*Microscopical Pathology*

| Type of appendicitis | No. of cases | Serosa only | Suppuration | Obliterative | Normal | No record | Appendix not removed | Per cent. mortality |
|---|---|---|---|---|---|---|---|---|
| Interval or chronic | 339 | 104 | 9 | 11 | 203 | 12 | 0 | 0.3 |
| Acute suppurative | 72 | 20 | 47 | 0 | 0 | 5 | 0 | 1.4 |
| Acute suppurative with local peritonitis | 156 | 19 | 136 | 0 | 0 | 1 | 0 | 2.5 |
| Acute suppurative with abscess | 112 | 2 | 103 | 0 | 0 | 0 | 7 | 9.7 |
| Acute suppurative with diffuse peritonitis | 21 | 0 | 20 | 0 | 0 | 0 | 1 | 38.0 |
| Totals | 700 | 145 | 315 | 11 | 203 | 18 | 8 | 3.4* |

* Average.

*Clinical findings.*—When one considers only the symptoms and the physical examination of each case, the clinical picture is not always an exact index of the severity of the infection present in the appendix and surrounding peritoneum. In a large proportion of cases, however, one can prophesy with a

fair degree of certainty the surgical findings and the prognosis for each case. In the uncomplicated cases of acute appendicitis, 80 per cent. were classified as mild or only moderately severe, while the remainder, 20 per cent., were considered severe. In the cases with abscess formation, a much smaller proportion showed only mild symptoms, about 13 per cent., while the other 87 per cent. were severe. In this latter group were included three cases in a moribund condition when admitted. In cases with local peritonitis 84 per cent. gave histories suggesting a severe process, while only 16 per cent. were considered mild. Where there was diffuse peritonitis no mild cases were recorded and more than a half of such cases were classified as severe with four considered moribund. Generally, therefore, the clinical findings are in agreement with the severity of the surgical condition.

When we analyze the cases that died, it would seem that the clinical findings are of less value in making a prognosis on a case than they are in determining the surgical condition. Out of the twenty-four deaths, one was considered as mild on admission, six as only moderately severe, fourteen as severe, and three as moribund. One patient died as a result of an interval operation.

As it is impossible to determine the exact surgical condition present and the final outcome of the case from the clinical findings, procrastination should always be avoided and immediate appendectomy carried out.

*Time factor.*—The number of hours between the onset of symptoms and the time of operation is important. The average time for the 228 cases with the disease localized to the appendix and neighboring peritoneum was thirty-six hours, while eighty-six hours had elapsed in the cases with abscess formation. However, the average time for the cases with diffuse peritonitis was sixty-one hours—less than that for abscess formation. Those with peritonitis were brought to the hospital somewhat sooner, probably because the symptoms were more rapidly progressive in severity, whereas in those cases with abscess formation there was often a definite history of relief for a number of hours

TABLE II

*Leucocyte Count*

| Appendicitis | Leucocytes | | | Polymorphonuclears (per cent.) | | |
|---|---|---|---|---|---|---|
| | Average | Highest | Lowest | Average | Highest | Lowest |
| 1. Interval | 8,000 | 9,000 | 5,000 | 67.6 | 96.0 | 33.0 |
| 2. Suppurative | 13,600 | 29,000 | 7,000 | 78.3 | 93.0 | 50.0 |
| 3. —with local peritonitis | 14,800 | 30,000 | 3,000 | 87.4 | 96.0 | 52.0 |
| 4. —with abscess | 18,000 | 48,000 | 4,000 | 80.1 | 95.0 | 32.0 |
| 5. —with diffuse peritonitis | 19,000 | 42,000 | 5,000 | 84.3 | 94.0 | 32.0 |

with a later relapse. Marsch reviewed 9000 cases and found that the mortality rate for those patients operated upon during the first twenty-four hours

was 1.1 per cent., for the second twenty-four hours 1.8 per cent., for the third, 4.8 per cent. and for those of four days or over 11.7 per cent.

Generally the degree of leucocytosis indicates the amount of body resistance, and the degree of neutrophil increase the severity of the inflammatory process. A low count may mean a mild infection, a walled-off abscess with cessation of absorption of the exudate, or poor body resistance. Three cases in this series died with leucocyte counts of 3,600, 3,900, and 4,950 respectively. The polymorphonuclear count is a fairly accurate indication of the severity of the infection. From the above table it would seem that peritoneal inflammation gives a higher count than does the presence of pus walled off in an abscess. In two cases that died with abscess formation the counts were 32 per cent. and 59 per cent. respectively. Both these cases had leucocyte counts of less than 5,000.

TABLE III

*Temperature and Pulse Rate on Admission to Hospital*

| Appendicitis | Temperature | | | | | Pulse rate | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 99° | 100° | 101° | 102° | 103° | 90 | 99–110 | 120 | 130 |
| 1. Interval | 294 | 33 | 8 | 3 | 1 | 292 | 38 | 8 | 1 |
| 2. Suppurative | 33 | 31 | 4 | 4 | 0 | 43 | 25 | 3 | 1 |
| 3. —with local peritonitis | 63 | 56 | 22 | 13 | 2 | 91 | 44 | 18 | 3 |
| 4. —with abscess | 37 | 23 | 23 | 20 | 9 | 36 | 45 | 24 | 7 |
| 5. —with diffuse peritonitis | 1 | 3 | 3 | 5 | 9 | 2 | 4 | 7 | 8 |

As one would expect, the temperature and pulse rate rise proportionately to the severity of the disease. However, appendicitis is seldom accompanied by a high temperature. Only 16 per cent. of the acute cases had a fever of more than 101° and only 5.6 per cent. of more than 102°.

*Rectal examination.*—In the interval cases there were 117 rectal examinations noted with sixty-seven negative findings; forty-nine showed some tenderness on the right side. In the acute suppurative cases fifteen examinations were negative, twenty-five showed tenderness on the right, and in three a mass was palpated. Where local peritonitis was present, nineteen examinations were negative and sixty showed tenderness, while in two instances a mass was felt. In the abscess cases twenty-eight showed tenderness against twenty-five negative examinations and in ten cases a mass was present. The cases with diffuse peritonitis showed the highest proportion of rectal tenderness, being thirteen out of the fourteen examinations recorded.

*Urine examination.*—The urine was examined in each case before operation was performed. Any case showing pus- or red blood-cells with an indefinite history for appendicitis or a history suggestive of a urinary disorder was studied further. An X-ray examination of the urinary tract and a cystoscopic examination was made whenever it was thought necessary to determine the presence or absence of calculi. That pus- red blood-cells, and

cases are often present in the urine coincident with acute appendicitis is shown in the table below. There was one case with gross hæmaturia. Probably the presence of pus- or red blood-cells is due to one of the four following conditions: (1) Action of toxins on the kidney by way of the blood-stream; (2) direct involvement of the kidney itself by extension of an abscess upwards and retroperitoneally; (3) creation of an ureteritis by an inflamed appendix lying in contact with the ureter; and (4) inflammation of the bladder due to an appendiceal abscess in the pelvis, especially when the bladder forms part of the abscess wall.

TABLE IV

| Appendicitis | Pus | Red blood-cells | Red and white blood-cells | Red and white blood-cells casts |
|---|---|---|---|---|
| 1. Interval | 0 | 0 | 0 | 0 |
| 2. Suppurative | 2 | 1 | 3 | 0 |
| 3. —with local peritonitis | 5 | 5 | 3 | 1 |
| 4. —with abscess | 5 | 0 | 3 | 0 |
| 5. —with diffuse peritonitis | 2 | 0 | 3 | 1 |

In Table V are summarized some of the clinical findings according to different surgical-pathological groupings.

TABLE V

*Analysis of Seven Hundred Appendectomies*

| Type of appendicitis | No. of cases | Average white blood-cells | Average poly-nuclears (per cent.) | Temperature over 101° (per cent.) | Pulse over 120 (per cent.) | Abnormal urine (per cent.) | Mortality (per cent.) |
|---|---|---|---|---|---|---|---|
| Interval or chronic | 339 | 8,000 | 67 | 3 | 3 | 0 | 0.3 |
| Acute suppurative | 72 | 13,000 | 78 | 6 | 6 | 7 | 1.4 |
| —with local peritonitis | 156 | 14,000 | 87 | 10 | 12 | 9 | 2.5 |
| —with abscess | 112 | 18,000 | 80 | 26 | 30 | 8 | 9.7 |
| —with diffuse peritonitis | 21 | 19,000 | 84 | 70 | 75 | 30 | 38.0 |

*Mortality.*—Out of the 700 cases there were twenty-four deaths, or a 3.4 per cent. mortality. It is regrettable that the rate should be as high as this. Unfortunately, however, the patient, and too often the doctor, procrastinate too long and the disease ceases to be confined to the appendix.

Six hundred thirty-six out of the 700 operations were performed by ten men who were or are still serving their Fellowships in Surgery. The remaining sixty-four were performed by five Senior attending surgeons.

Nearly all of patients were transported by automobile or train many miles from all parts of the state before they arrived at the hospital. Cases with signs of rapidly spreading peritonitis and those in very poor condition are probably best treated expectantly for a few days until they are in better

condition to stand operation. Formerly it was rule at the University Hospital to operate immediately on all cases of acute appendicitis, unless they were in a moribund condition. Lately, however, when the diagnosis of diffuse peritonitis is definite, we wait until that process has had an opportunity to localize itself.

The following general principles have been carried out in nearly all of the cases. No matter what the hour, as soon as the diagnosis of acute appendicitis has been established, operation was performed. Appendectomy was always done unless the appendix could not be found readily in an abscess wall. Out of the 113 cases with abscess, the appendix was not removed seven times. On discharge from the hospital these patients were instructed to

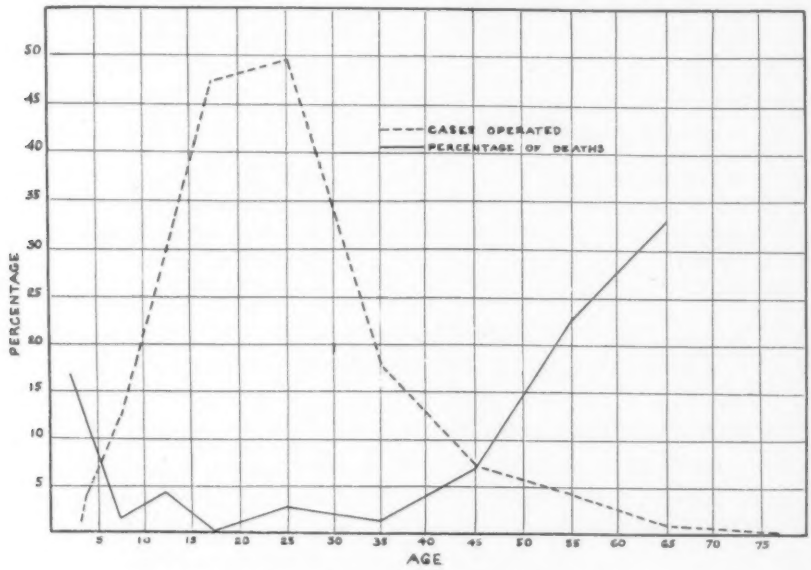


FIG. 3.—Mortality percentage according to age.

return later for appendectomy. The appendiceal stump was inverted with a purse-string suture of linen after the local application of phenol and alcohol. When the cæcum was œdematous and friable this was not attempted; instead, the stump was transfixed and tied with chromic catgut. Fecal fistulæ occurred in only three cases.

An enterostomy was performed once. Quain and Waldschmidt report a primary enterostomy in thirty-one cases and a secondary enterostomy in thirty-eight cases in a series of 1000.

A right rectus incision was employed 519 times, a McBurney incision fifty-nine times, a Battle incision 111 times, and a mid-line incision nine times. At the present time McBurney's is being most favored as it reduces appreciably the patient's hospital stay, and, if exposure is inadequate, it can always be enlarged either upward through the oblique muscles or downward into the rectus sheath.

Ether and ethylene anæsthesia was used in nearly all of the cases. Local anæsthesia was used in some that were too ill to stand ether inhalation, especially when there were pulmonary complications present. At the present time we use spinal anæsthesia in practically all of our adult cases.

Appendectomy was performed without drainage 482 times and with drainage 204 times. Seven abscesses were drained without the removal of the appendix.

Of the twenty-four deaths, nineteen occurred in males. It is possible that men wait longer than women do before they seek medical treatment. During the second and third decades is found the greatest case incidence, but the lowest mortality percentage. Over 70 per cent. of the deaths occurred before the age of fifteen or after the age of forty. These two periods include only 30 per cent. of all the cases. Children under twelve years of age stand operation better than adults over forty. The mortality rate among the former was 6.3 per cent. while in the latter, or older group, it was 16.0 per cent.

The following post-operative complications were recorded on the charts:

| | | | |
|---|---|---|---|
| Post-operative pneumonia | 16 | Pyelonephritis | 1 |
| Subdiaphragmatic abscess | 4 | Massive collapse of lung | 1 |
| Fecal fistula | 3 | Severe cystitis (catheterization) | 1 |
| Evisceration | 2 | Toxic urticaria | 1 |
| Spontaneous abortion | 2 | Measles—post-operative—three days | 1 |

The average stay in the hospital was 21.4 days, the longest time being 152 days. In children, Beekman found the average stay to be twenty-two days for 145 cases.

Autopsies were done on eighteen out of the twenty-four cases that died. The most common cause of death was peritonitis often complicated by ileus, pneumonia or both. The patient that died in the interval group was very obese, and because of a long exploratory procedure, developed an acute ileus which caused his death. One case was in a tabetic in whom no adequate organic basis could be found to account for his demise. The appendix showed suppuration microscopically.

*Causes of death.*—Peritonitis, 8; pneumonia, 3; peritonitis and pneumonia, 3; peritonitis and ileus, 4; peritonitis, ileus, and pneumonia, 3; ileus and bronchopneumonia, 1; peritonitis and subdiaphragmatic abscess, 1; no reason except tabes dorsalis, 1.

## SUMMARY

1. Sex incidence is equal when all cases are considered, but when the acute cases are separated we find 70 per cent. are in males, while in the chronic cases, the exact reverse is true, with 70 per cent. occurring in females.

2. The peak age incidence is during the second and third decades.

3. The seasonal incidence was highest in summer in this series.

4. A history of recent or coincident infection elsewhere in the body was present in 5.8 per cent. of the cases.

5. There were 339 interval cases with a mortality of 0.3 per cent., 72

acute suppurative cases with a mortality of 1.4 per cent., 156 cases with localized peritonitis with a mortality of 2.5 per cent., 112 cases with abscess formation with a mortality of 9.7 per cent., and 21 cases with diffuse peritonitis with a mortality of 38.0 per cent.

6. The type of the disease is in a large part dependent upon the length of time between the onset of the symptoms and the time of operation.

7. In a large proportion of cases it is possible to correlate the clinical picture with the surgical findings. In a small proportion, however, the clinical picture may be very misleading, and it is in this group particularly that there lies great danger of procrastination when immediate operation should be done.

8. Clinical findings are less reliable in determining the prognosis of a case than they are in indicating the probable surgical condition present.

9. A high leucocyte count accompanied by a high polymorphonuclear count usually means good body resistance to a severe infection. This, however, does not prove true in all cases. A leucopenia usually means a poor prognosis.

10. Temperature and pulse are usually but slightly elevated. In children and in the cases with diffuse peritonitis both tend to be higher than in the remainder of the cases.

11. Twenty-eight cases showed pus- red blood-cells or both in the urine.

12. The mortality rate for the entire series was 3.4 per cent. Mortality is highest in the male sex (nineteen out of the twenty-four cases) and highest in children and in the aged.

13. Although an increasing mortality rate according to vital statistics is reported, the operative mortality or fatality rate for appendicitis has decreased. Dividing the 75,858 cases collected into three periods, the average reported operative death rate for the years 1902 to 1910 was found to be 7.6 per cent., decreasing to 5.7 per cent. for the years 1910 to 1920 and to 3.5 per cent. for the years 1920 to 1929.

14. Early diagnosis followed by immediate appendectomy offers the best hope for the reduction of the mortality rate in acute appendicitis.

# ACQUIRED MEGACOLON

By Harold J. Shelley, M.D.
of New York, N. Y.
from the surgical service of St. Luke's Hospital

This case, due to stricture in the descending and sigmoid colon, is reported because the enlargement of the colon developed while the patient was under our observation; and also, because he has a duodenal diverticulum. Röntgen-ray examinations made soon after the symptoms of partial obstruction developed, and direct examination at the time of operation revealed a normal colon above the sigmoid and descending portions. At the present time röntgenograms show a typical megacolon.

*Literature.*—In most discussions of megacolon the cases are divided into two groups—the congenital type (true Hirschsprung's disease) and the acquired type. The latter includes all those cases which develop after birth. They are due to a partial obstruction which may be intermittent.

Magoun[1] adds an intermediate group which includes those cases developing the typical picture, clinically and in röntgen-ray findings, of megacolon some time after birth without any demonstrable obstruction. A brief review of the literature revealed no case reports in which röntgenograms had been made previous to the development of the megacolon.

Mummery[2] collected 100 cases of megacolon. Fifteen of these had some associated congenital anomaly. Twenty-three had either a partial or an intermittent obstruction. The age incidence was greatest in infancy and after the age of ten years decreased gradually to age seventy. He stated that the age incidence table disproved megacolon is of two types and concluded that the older patients were merely congenital cases in which the patients had survived.

Bailey[3] reported a case of dilatation of the colon in an infant with an imperforate anus. He considered the cause partly congenital and partly mechanical. The possibility of a wholly congenital origin cannot be disproved. The same conclusion would hold for the six cases of simple congenital anorectal stricture with megacolon in early infancy reported by Bremernan.[4]

However, Vernon David,[5] who reported three similar cases, favored the conclusion that at least a part of the megacolons found in infancy were developmental rather than congenital. One of his cases came to autopsy one month after an operation which had relieved the stricture. Only a hypertrophic and somewhat larger than normal sigmoid was found. Before operation röntgenograms had shown the sigmoid filling nearly the entire abdomen. The other two cases became normal clinically after relief of the stricture, but no röntgenograms which had been made after operation were mentioned.

This suggests an explanation for those cases mentioned by Gant[6] in which a megacolon of the sigmoid portion had been excised and then later developed a megacolon of the remaining portions of the colon. Possibly these patients had an unrecognized partial rectal diaphragm or stricture or some other partial obstruction.

Mummery[7] reported a case in which the patient, a man fifty-four years of age, was normal for the first thirty-seven years of his life. Then following an attack of dysentery he developed a severe constipation, followed by the typical symptoms of megacolon. Röntgenograms showed a sigmoid which filled almost the entire abdomen

with the dilatation extending down to the anus. Just within the anus was an adenocarcinoma which Mummery attributed to the chronic irritation from the great amount of fæcal material which accumulated over periods of weeks.

Lefèvre and Jonchères[8] and Rankin[9] reported cases secondary to cancer of the sigmoid. Macaige and Fleury[10] reported a case due to pressure on the rectum by a tumor outside of the rectal wall. In these cases the megacolon may have been present before the so-called cause. Vernon David[5] mentioned a case reported by Treves in which the pelvic rectum was tubular and the size of an adult index finger.

Case Report.—T. S., a negro laborer, aged sixty-one, entered St. Luke's Hospital, July 19, 1923, complaining of vomiting and loss of weight. Beginning six weeks before admission, he had been ill for two weeks with pneumonia. One week later he developed gaseous eructations, with which he had nausea and vomiting. This occurred immediately after, or three to four hours after meals.

His abdomen had been distended and considerable flatus expelled. During this six weeks he lost fifty pounds in weight and suffered a marked loss of appetite. Bowel movement occurred by catharsis only. Mucus and blood were noticed in the stool although no blood was seen in the vomitus. There had been some pain about the umbilicus and left flank. At the time of admission the amount of distention and vomiting was decreased.

He had had dysentery for six months in 1918, and rheumatism in practically all his joints at the same time. He was called a typhoid carrier in 1893. A chancre was contracted in 1888 and gonorrhœa in 1883. In 1903 he was told his urine contained sugar. For many years he had had frequent colds and attacks of bronchitis, but never any hæmoptysis or night sweats.

Fig. 1.—The abdomen between attacks of distention.

He was a well-developed, somewhat emaciated man who appeared acutely ill. The pupils showed definite reflex rigidity. The abdomen was symmetrical with moderate tenderness to pressure in the right upper quadrant. There were no palpable masses, demonstrable fluid or hernias. Very little distention was present. The knee-jerks could not be elicited.

Rectal examination revealed no palpable pathology. Proctoscopic examination was negative to the height of 6 inches but for a moderate amount of bloody mucus on the rectal mucosa. No amœba were found in this mucus.

The blood count and urinalysis were normal. Blood and cerebrospinal fluid Wassermann reactions were negative. The phenolphthalein output of the kidneys was normal. A two plus reaction was obtained on the two occasions when the stool was examined with guaiac for blood.

*Röntgen-ray Examination.*—A barium injection of the colon was done July 23.

1923, and reported as follows: (1) Fluoroscopic examination and films taken at the time of the injection reveal an incompetency of the ileocæcal valve. The right portion of the colon is moderately dilated. The descending colon and first portion of the sigmoid are narrow. This finding is constant in all exposures.

(2) Films fifteen minutes after injection are the same as noted above.

(3) Films twenty-four hours after injection show traces of barium as far back as the cæcum with retention in the appendix. The descending colon still appears narrow.

(4) In films made forty-eight hours after the injection there is retention in the appendix, and stasis in the colon with narrowing of the descending colon.

July 29, 1923, he was transferred to the surgical service with a diagnosis of tubular stricture of the descending and sigmoid colon probably caused by the six months' attack of dysentery in 1918 with subsequent scar formation and contraction. Operation was done by Dr. H. H. M. Lyle on July 31, 1923. Through a left rectus incision the abdomen was explored. Bands across the descending and sigmoid colon were ligated and cut.

The cæcum was ballooned up and well over toward the mid-line. The ascending

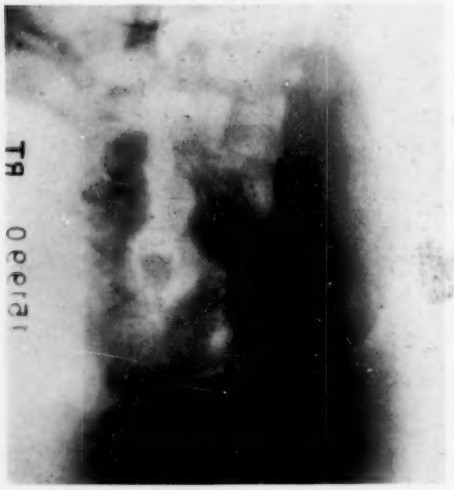

FIG. 2.—Ten-minute gastric röntgenogram. Note the duodenal diverticulum showing between the pylorus and duodenum.

FIG. 3.—Röntgenogram twenty-four hours after barium meal. The lower end of the stricture in the sigmoid shows below the barium retained in the colon.

colon was normal. The transverse colon at about the midportion was collapsed. The splenic flexure could be made out and was normal.

Just below the splenic flexure the colon became cord-like, about 1.5 centimeter in diameter and was adherent throughout its entire length to the parietal peritonæum posteriorly. The sigmoid and upper rectum were a continuation of this condition. Extending over the involved area were several bands of inflammatory tissue crossing the colon at various angles. They appeared to be of old origin. There was no way to identify the sigmoid or rectum because the cord-like structure was continuous throughout. Gas could be forced through the stricture. No area was found suitable for anastomosis distal to the stricture. The abdominal wound was closed.

*Post-operative Röntgen-ray Examination.*—A barium enema was given August 22, 1923, twenty-two days post-operative.

(1) Fluoroscopic examination and films taken at the time of the injection show moderate dilatation of the right portion of the colon. The narrowed portion begins just below the splenic flexure and extends down as far as the junction of the sigmoid colon and rectum. It has the somewhat irregular appearance which was described

before the operation. The rectum is definitely not contracted as seen when the barium first enters that structure.

(2) Films made thirty minutes after elimination reveal no change except that some of the injection has been eliminated.

(3) In films made twenty-four hours after the injection, traces of the injection are seen as far back as the cæcum. The major portion of the injection has been eliminated. This is a marked improvement over the retention shown in the pre-operative films.

*Follow-up Record.*—The post-operative course was uneventful and patient was discharged improved August 24, 1923. He had not been distended or constipated and appeared to be clinically cured up to the time of his discharge.

His history for the next seven years was that of constipation which required constant care. It was so controlled by diet, catharsis and frequent enemas that the patient was able to work regularly. His weight and general condition remained about the same. During this time his prostate enlarged gradually to the size of a small orange with the typical symptoms of partial urethral obstruction.

August 5, 1930, because of the continued troublesome constipation and frequent attacks of abdominal distention, gastro-intestinal röntgenograms were made. These showed the stomach to be normal. A definite duodenal diverticulum filled and contained barium still in the six-hour films. The large bowel appeared to be enormously distended and a long stricture showed in the lower sigmoid.

August 13, 1930, the colon was examined by clysma and showed a marked distention which appeared to include its three parts. The transverse and ascending colon were enormously distended with gas—definitely, the picture of a megacolon.

He was admitted to St. Luke's Hospital immediately after the clysma because of nausea, vomiting and abdominal pain. The night before he had been given a large dose of castor oil and before the clysma a soapsuds enema, but had had no return from either.

FIG. 4.—Barium enema filling only the distal loop of the large megacolon. The remaining loops are distended with gas. Patient's condition did not permit a larger enema.

His physical examination was very little changed from that of his first admission. He was somewhat more emaciated. His abdomen was enormously distended and so tense that no impression could be made on it with the examining hand. The prostate was so large that examination of the rectum with the finger or a proctoscope was impossible.

Two enemas were entirely unsuccessful. Preparations were made for doing a cæcostomy as first stage to making a short circuit around the stricture. Just before the patient was to have been taken to the operating room, he was able to expell a large quantity of gas and barium. The operation was postponed and by the next morning he was completely relieved. Because of his age and past history, he was sent home and has returned to work.

*Summary.*—When first seen this patient had an inflammatory stricture of the descending and sigmoid colon. Röntgen-ray and direct examination showed a normal colon proximal to the stricture. The cæcum was moderately distended.

After seven years of constipation and mild attacks of obstruction relieved by cathartics and enemas, he now has a definite and large megacolon as shown in the röntgenogram. These pictures also show a duodenal diverticulum.

NOTE.—The first two Röntgen-ray reports are given in detail as the films were all destroyed following the Cleveland Clinic fire. Only colon films were made at the time of the original admission; consequently the duodenal diverticulum was not discovered then. This entire report is quite long for two reasons—first, it covers a period of seven years and two admissions to the hospital; second, because it is unique and was thought to be of sufficient importance to require considerable detail.

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# IS TOXÆMIA THE CAUSE OF DEATH IN UNCOMPLICATED INTESTINAL OBSTRUCTION?

By Herman E. Pearse, Jr., M.D.

of Rochester, New York

FROM THE DEPARTMENT OF SURGERY OF THE UNIVERSITY OF ROCHESTER

These experiments are not presented as proof of a thesis but are offered as evidence in support of the point of view that toxæmia is relatively unimportant in causing death from simple intestinal obstruction. The bulk of the work on this subject has been directed by the opposite opinion and many ingenious experimenters have sought to demonstrate the toxin and its mode of action, yet it has never been isolated and its nature has remained clothed in mystery and a subject of conjecture. From time to time there have been dissenting voices[2, 3, 9, 10] which stated that other factors, such as loss of food, fluids and normal secretions, might be responsible for the fatal result, but the general cry of "find the toxin" still prevails. That these substances are lost is not doubted, for even without vomiting their accumulation in a distended bowel renders them just as useless to the organisms as would their elimination. So it would appear that their loss may have influence and serve to confuse the issue by adding a multiplicity of factors to the lethal effect. By their conservation the influence of the toxin alone may be judged. This would necessitate retention of gastric and duodenal secretion (including bile and pancreatic juice) and administration of food and fluid. An experiment was planned to shunt all of these substances below the point of obstruction but for technical reasons only a part of the gastric secretion could be retained. This gives opportunity for the evaluation of the effect of the toxin alone without the complication of other factors. Surprisingly enough, if the upper-tract secretion combined with food and fluid is retained by its absorption below the point of obstruction, then no true toxæmia develops.

*Method.*—Adult dogs are used as experimental animals. The three-stage operative procedure is shown in Fig. 1. The first stage consists of mobilization of the duodenum at Treitz ligament, transection of the stomach, closure of the distal end and anastomosis of the proximal end to the upper jejunum. The second stage is done by cutting the end of the duodenum free from the gastric anastomosis, turning in the blind ends and anastomosing the duodenal segment into the jejunum at a point about 50 centimetres below the gastrojejunal anastomosis. At the third stage, a gastrostomy is done in the blind distal gastric segment and the jejunum is obstructed above the anastomosis with the duodenum. An attempt to shorten the operative procedure by combining the first and second stage was made, but this resulted in the death of five out of seven animals and was abandoned. It is possible to omit stage two by bringing down the duodenal segment and, after obstructing the jejunum, implanting it into the distal jejunal loop with an end-to-end anastomosis.

After the final operation for obstruction the animals are fed a liquid diet, consisting largely of milk, through the gastrostomy opening, and water is also supplied by this route. Since a portion of the stomach is in the obstructed loop, then some gastric secre-

tion is lost by vomiting and hence the chlorides may be depleted after an interval of about two weeks. If this occurs, one or two grams of NaCl are added daily to the diet until the normal balance is reëstablished. (See Fig. 2.) The animals are allowed food and water by mouth *ad lib.* Blood for chemical estimation of the non-protein

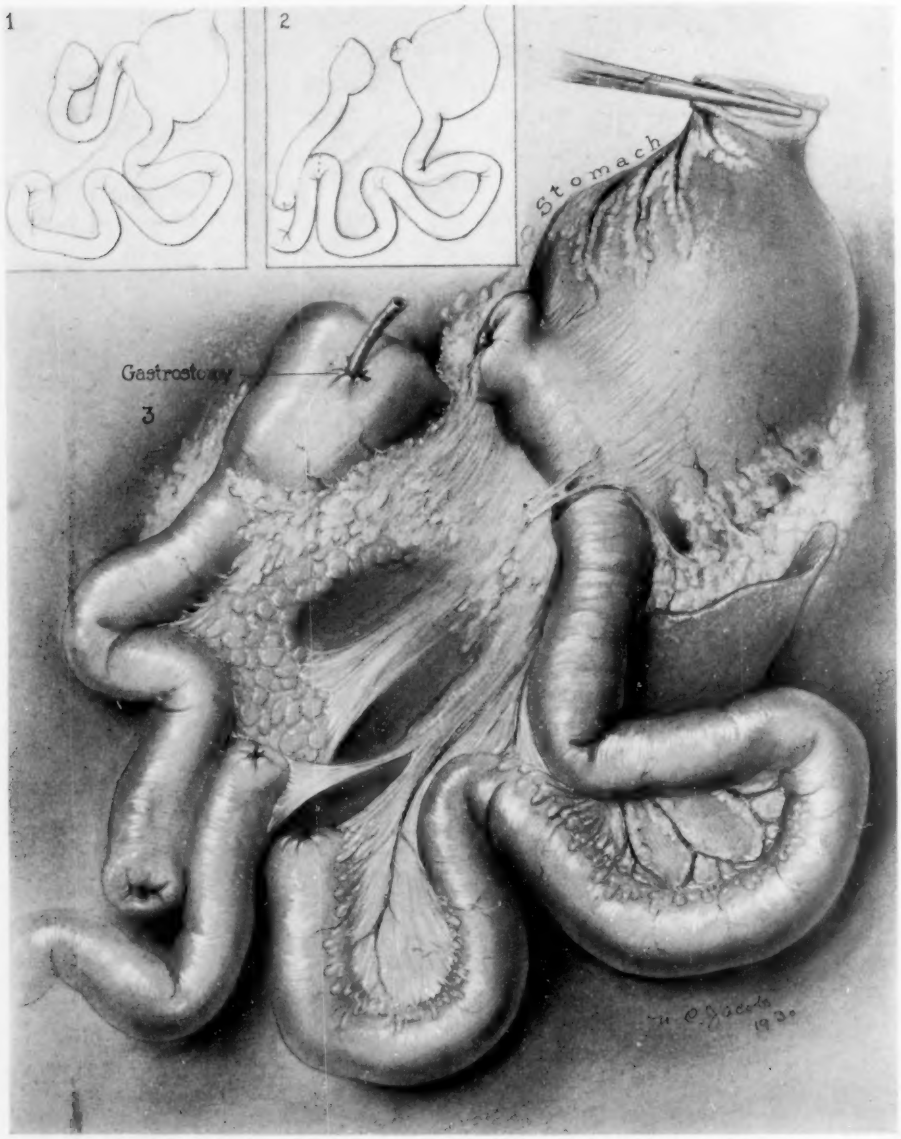


FIG. 1.—The operative procedure, done in three stages, is designed to divert the bile, pancreatic juice, duodenal and a part of the gastric secretion to a point below the intestinal obstruction. Food and fluid are supplied through the gastrostomy.

nitrogen chlorides and carbon-dioxide combining power is taken before and at frequent intervals after the obstruction. The contents of the obstructed loop are examined bacteriologically, especially for B. welchii.

*Results.*—In all, fifteen dogs were operated upon, of which seven died from various causes before obstruction. After the final operation for obstruction, one dog died in twenty-four hours and another animal died in twelve days from a poorly functioning

duodenal anastomosis, leaving six obstructed dogs for study. These animals either died or were sacrificed at the end of a month. None of them developed the toxæmia of intestinal obstruction as we ordinarily conceive of the term. They vomited from time to time a very foul vomitus containing B. welchii and other organisms but they did not develop the rapid onset of lethargy, weakness, stupor or blood-chemistry changes (see Fig. 2) that are associated with intestinal obstruction, nor did they die at the usual time. On the contrary, they are alert and active and appear to be in good health for at least two weeks after the obstruction. At the end of this time they gradually

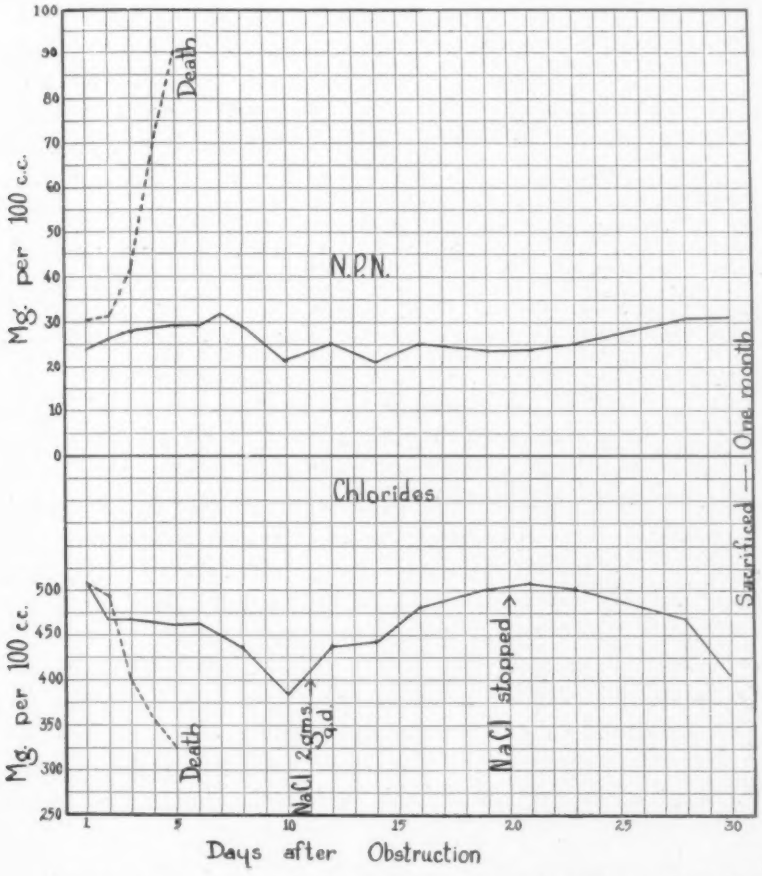


FIG. 2.—A comparison of the blood-chemistry changes in simple, experimental, intestinal obstruction: (*a*) with conservation of upper-tract secretion, food and fluid (solid line), and (*b*) in the usual experiment with the loss of these substances (broken line) in which the N. P. N. rises, the chlorides fall and early death occurs. Both dogs have a high obstruction at a point 40 centimetres from the stomach. The influence of the addition of NaCl to the diet is shown.

begin to lose weight and as this progresses there may be associated loss of strength so that a state of inanition or chronic nutritional disorder develops. This condition becomes very pronounced at the end of a month and the animals often develop an intercurrent infection, an intractible diarrhœa or a chronic sore from pressure of the dressings and may die. Habler[4] has shown that a somewhat similar operative procedure but without the intestinal obstruction causes this same metabolic disturbance.

*Discussion.*—Since the animals survived for a month, it seemed evident verification of the criteria of the experiment. They were sacrificed at the expiration of that period. At that time they were usually sick and always

cachectic and in a state of inanition, but this condition was quite different from the syndrome associated with the acute "toxæmia" of intestinal obstruction. The cause of this state of inanition is an interesting problem in itself but is without the province of this study. It may be associated with a derangement of absorption of the upper-tract secretions which are diverted to an abnormally low point in the small intestine.

The fact that when starvation, dehydration and loss of normal secretion are eliminated from simple intestinal obstruction, no toxæmia results is interpreted to mean that no specific toxæmia exists. There are other proponents of this opinion and additional evidence may be presented for its support. Habler[4] and Jenkins[6] have performed experiments somewhat similar in principle with the same result but have held the interpretation that the duodenal contents are necessary for the formation of a toxin in intestinal obstruction. Jenkins mentions the alternative that these secretions may be necessary for the preservation of life. Dragstedt and Ellis[1] have shown that the loss of gastric secretion is fatal in a few days. That the loss of upper intestinal juices is harmful has been stated by Wilkie[10] and may be inferred from the results of Haden and Orr[5] who found that obstructed dogs having a simultaneous jejunostomy live a much shorter time than do those with only obstruction. There is experimental[7] and clinical evidence to show that if the contents of the obstructed loop are allowed to remain after the obstruction is relieved recovery may be more rapid than with its removal. Perhaps the most convincing evidence is from the experiments of White and Fender[9] who collected the vomitus from obstructed dogs and reinserted it through an enterostomy below the obstruction. This procedure would give the greatest chance for absorption of a toxin if it were present, but not only did the animals live but also they showed no evidence of toxæmia.

A consideration of these data permits of the interpretation that in simple, uncomplicated, intestinal obstruction, there is no need for the theory of death from a specific toxin for the loss of upper-tract secretion combined with anhydræmia and starvation is sufficient to cause the lethal effect. Conversely, with the conservation of food, fluids and normal secretion no specific toxic effect is noted from the intestinal obstruction.

It must be borne in mind that the addition of tissue damage, strangulation and peritonitis to this result materially complicates the picture and these must be studied as individual factors. It is possible that they produce their effect by creating a portal of entry to the blood-stream for the deleterious products normally present[8] in intestinal contents and not by the formation of a specific toxic substance.

It follows that if the data are interpreted to mean that there is no specific toxin resulting from simple intestinal obstruction, then therapeutic efforts should be directed toward the relief of anhydræmia and starvation, but, much more important, to the preservation and restitution of the substances lost in the gastric and duodenal contents. The demonstration by Haden and Orr[5] of the beneficial effect of the administration of fluids and of the chlorides lost from the gastric juice is one of the important contributions to the treat-

ment of this condition. The effect of restitution of the substances lost from the duodenal secretion, bile and pancreatic juice is an unexplored field. Early operative intervention is indicated to relieve obstruction and to prevent tissue damage from excessive distension, strangulation or peritonitis but for those procedures designed to drain off the "toxic" contents of the obstructed loop will be substituted measures to conserve these secretions. Thus it is seen that the adoption of the point of view that toxæmia is relatively unimportant in causing death from simple, intestinal obstruction suggests stimulating possibilities of new methods of treatment.

## CONCLUSIONS

1. Studies on the toxæmia of simple intestinal obstruction are complicated by the factors of loss of upper-tract secretion, anhydræmia and starvation.

2. The shunting of food, fluid, and the secretions in the stomach and duodenum to a point below the obstruction results in the absence of manifestations of toxæmia.

3. This is interpreted as evidence in favor of the point of view that no specific toxin is produced by simple intestinal obstruction.

4. The complications of tissue damage, strangulation and peritoneal contamination add other factors to the effect of the original obstruction and must be analyzed separately.

5. From the practical standpoint of the care of patients with intestinal obstruction it is safer to assume that they all have potential or actual tissue damage from distention or strangulation and to institute early operative intervention for its relief.

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# THE SURGICAL ASPECTS OF ASCARIASIS

By Earle I. Greene, M.D., and J. Major Greene, M.D.
of Chicago, Ill.

In considering diseases requiring surgical intervention ascariasis is rarely thought of, for while harmless in most instances, it may, at times, produce the most imposing pathological states. Because of its comparative rarity in this part of the country cognizance of its ability to produce major surgical conditions is frequently overlooked. The examination of stools for the detection of these parasites will become more frequent, if we bear in mind clearly the serious disturbances which may arise as a result of their presence.

It is indeed important to understand the cycle of development in man, since the worm in both its larval and adult stages is actively migratory. Briefly, the course of development is as follows:

The eggs pass out the intestines of an infested animal (pig or man) in the fæces. The eggs, however, are not infective until the contained embryos develop to a vermiform stage, which requires a period of two weeks or more, according to the temperature of the surrounding medium, oxygen supply and moisture. Accidently the embryos may hatch outside the body, but in this case they perish quickly. Within the highly impermeable egg-shell, the fully developed embryo is very resistant to cold, dryness and other unfavorable conditions and may remain alive for long periods of time—five years or possibly longer. If swallowed by some mammal, the eggs that contain fully developed embryos hatch in the small intestines. They will also hatch if artificially introduced beneath the skin.

Unless accidentally carried out of the body in the fæces, the newly hatched larvæ penetrate the wall of the small intestines and pass into the blood-stream to the liver, though some possibly go more directly to the heart; in both cases apparently aided by the circulation. From the liver, where they remain in most cases only a few days, they migrate to the lungs, evidently by the hepatic veins, inferior vena cava, heart and pulmonary arteries. They are stopped in the lungs by the capillaries, enter the air vesicles and bronchioles, pass up the bronchi and trachea, then pass into the œsophagus and finally reach the small intestine, where, if the animal infested is a suitable host, they establish themselves and continue their development to maturity.

Ascaris lumbricoides is famous for its habits of wandering about and making its appearance in strange places, and it is not surprising that disturbances resulting from the presence of the parasites in organs other than the intestines should frequently occur.

Recently one of us (E. I. G.) was called to operate on an acute surgical

abdomen. The diagnosis was not definite and was to be in the form of an exploratory laparotomy.

N. C., aged seven, was admitted to the hospital September 1, 1929, with the following history: On the preceding day the boy, who previously had been in perfect health, attended a party. He returned home that evening complaining of severe abdominal pain. On being questioned by his mother, the child stated that he had been kicked in the abdomen by one of his playmates while at the party. The boy was put to bed but all night complained of recurrent attacks of excruciating pain lasting from fifteen to thirty minutes. The following day the boy was admitted to the hospital.

His temperature was 101.2°, pulse 130, respiration 24. His white count was 12,000 and the differential count was reported to contain 78 per cent. polymorphonuclear leucocytes, 20 per cent. large lymphocytes and 2 per cent. small lymphocytes. The urine was negative. The red blood count read 4,370,000.

The abdomen was rigid with definite tenderness in the right lower quadrant. Rectally the patient had tenderness over the right side. A diagnosis of a ruptured viscus was made by the interne.

When the boy was seen by a surgical colleague the attack had subsided, the patient was comfortable and he could not substantiate the diagnosis of an intra-abdominal lesion.

The patient continued to have recurrent attacks of severe abdominal pain coming on at hourly intervals. The abdomen would become rigid, the boy would roll about in bed, hands clasped to abdomen, and become markedly cyanotic. After fifteen or twenty minutes the paroxysm would abate, the abdomen would become flaccid and the boy would apparently be normal, only to have a recurrence within an hour. The pædiatric department felt that it was advisable to explore the abdomen.

Although the diagnosis was not clear, yet with a history of recurrent abdominal crises following an injury to the abdomen, it was thought justifiable to explore the abdominal cavity. Before taking the boy to the operating room another differential count was made which revealed a 40 per cent. eosinophilia. Immediately a parasitic infection suggested itself and an examination of the stool, following a small enema, revealed many ova of ascaris lumbricoides. A diagnosis of incomplete intestinal obstruction due to round worms was made and treatment was instituted immediately. Within two days the boy passed a mass about the size of a walnut composed of some three hundred worms tightly packed together, and many free worms were found floating on top of the saline solution. The child's complete recovery then followed.

In reviewing the literature of ascariasis one immediately realizes that any of the abdominal organs may become the seat of a severe and often fatal disease.

*Intestinal Obstruction.*—Intestinal obstruction is probably the most common surgical condition resulting from the presence of the round worms in the intestinal tract. Two definite types of intestinal obstruction are recognized: an obturating type—as a result of the massed collection of worms, as was present in this case; and a spastic type which may be caused by only one or several worms.

The worms have a tendency to collect in masses and as they pass through the small bowel are hindered in their progress by the narrow lumen, resulting in an occlusion of the bowel. Just why the ascarides tend to congregate in masses has not been definitely established. Schlössmann is of the opinion that the clumping of the worms is due to their own movements and not to the action of peristaltic waves. In some portion of the bowel an ascaris

curls up. Others in the neighborhood trying to get into the smallest place possible work their way into the curled worm, soon forming a knot. The presence of such a collection of worms acts as a foreign body causing a spasm of the bowel.

Ascaris lumbricoides is famous for its singular tendency to get into tight places. Stiles has collected a number of interesting cases in which the worms were found threaded through the eye of a shoe button which had been swallowed. He cites another case in which a child had swallowed several dress hook eyes. When the eyes were finally passed each was threaded by a worm.

Rost, however, is of the opinion that a chemical secretion is given off by the worm which causes a spasm of the bowel. He found that an extract of the digestive and genital organs increase the tonus of the intestine of the cat, and concluded that spasm was due to the death and disintegration of the worm. Jaroschka, disagrees with this theory, and is supported by Sohn and Kuester, believing that the obstruction is mechanical.

Glass and Bloom report a case of acute intestinal obstruction in a boy of nine in which the duodenum and whole jejunum were tightly packed with masses of ascarides. Ludlow reports a case of acute intestinal obstruction in a boy of sixteen in which 30 centimetres of gangrenous bowel were found, but only five worms were present. Ludlow was of the impression that in his case obstruction was caused by the irritant action of the ascaris rather than by a mechanical occlusion. In the case reported by Alles, the worms were so tightly packed that upon opening the abdomen the bowel looked like a sausage, being about the size of the surgeon's arm.

Cases of intestinal obstruction due to ascaris lumbricoides have also been reported by Zoloff, Takaka, McGlannan, Perret and Simon, Levy, Watkins and Moss, Heiser, Holland, Baugh, Levin and Porter, Jaroschka, and Manhorya.

*Perforation of the Bowel* due to ascaris is not uncommon and the literature contains many such case reports. Ludlow reports a case of generalized peritonitis, the abdominal cavity being bathed in about one thousand cubic centimetres of milk-like pus. Three worms were found in the abdominal cavity. There was a hole in the ileum, one foot from the cæcum and through this hole another worm protruded.

Gilberti reports two cases of perforation of the intestines by ascaris. In both cases there were perforations present with worms free in the abdominal cavity. Schlössmann reports six cases of peritonitis in which the worms had perforated the bowel wall to lie free in the abdominal cavity. Frequently, cases of perforation and peritonitis due to ascaris lumbricoides, in which the worms are found in the abdominal cavity, yet in which no perforation can be demonstrated in the bowel wall, have been reported. The prevailing opinion is that the opening closes immediately after the passage of the worm. Whether an adult worm can go through a normal wall is questionable. Most authorities feel that some destructive process must first be present before the ascaris can perforate the bowel. Fleury and TaKeuchi have shown that there is local hyperæmia, œdema and necrosis present before perforation can occur. That some injury to the intestinal wall must take place before perforation ensues is beautifully illustrated by the report of Jaroschka in which during an operation for intestinal obstruction caused by round worms, the serosa of the small bowel at the junction of the jejunum and the ileum was torn, the muscularis and mucosa remaining intact. The serosa was then repaired and the abdomen closed. Two days after the operation the patient presented signs of diffuse peritonitis. It was thought that perhaps the suture line broke leading to a perforation. At the autopsy it was found that at the border of the jejunum and ileum where the tear had occurred two worms were found penetrating the wall, one extending 4 centimetres

through the wall, the other 10 centimetres. One worm was found under one of the sutures. The original suture line was intact. Jaroschka concludes that in handling cases of intestinal parasites, when it is necessary to open the bowel, in case of a tear, all layers and not only the serosa should be repaired. He also feels that if perforation is present during life the mucosa and muscularis must be damaged.

Gilberti concludes that the ascaris fastens itself to the bowel wall, setting up an irritation which leads to ulceration, necrosis and perforation. He admits that the mouth of the ascaris is able to injure the bowel wall directly, enough to entail perforation in time. Gerlach also makes mention of a case of ascaris ileus with peritonitis in which there were numerous areas spread throughout the bowel of definite disturbance in the mucosa, muscularis and submucosa, eventually leading to a perforation.

Wyss found the intestinal serosa turbid and dark red. One ascaris was found free in the abdominal cavity. Two more were coming through the hæmorrhagic intestines, and hæmorrhagic areas were found in the mesentery. The intestinal wall was necrotic in many places and very friable. Two perforations were found.

Freudenthal's case is remarkable in that a worm 25 centimetres long was found free in the abdominal cavity, but no evidence of any peritoneal reaction was found. His patient had been ill for six months and was finally operated, the diagnosis being "chronic appendix." At operation the ascaris was found and removed together with the appendix. The question arises as to the mode of entrance of the ascaris into the abdominal cavity. There being no evidence of peritoneal reaction, either healed or recent, rules out a perforation. Did the 25-centimetre worm grow from its larva in the abdominal cavity? This is an interesting conjecture but Freudenthal feels that it is the only logical conclusion.

*Pancreatic Disease Due to Ascariasis.*—Because of the ability of the worms to wander about, the pancreas has frequently been the seat of pathology. Rigby reports a case of acute pancreatitis in a woman of thirty caused by ascarides. At autopsy there was considerable fat necrosis throughout the peritonæum, including the under surface of the diaphragm. On opening the duodenum, an ascaris was found projecting from the ampulla of Vater into the lumen of the gut. The pancreatic duct was opened and the body of the ascaris found passing along the duct, then turning into the duct of Santorini, so that both ducts were blocked effectually.

Gallie and Brown report a case of acute hæmorrhagic pancreatitis caused by round worms, occurring in a child two and a half years old. The history was typical and at operation a blood-stained fluid with fat necrosis was found. The pancreas was large, swollen and covered by a mass of acutely inflamed omentum. Fifteen hours after operation the child vomited a full-sized round worm following which the convalescence was uneventful. The authors were of the opinion that the symptoms were the result of the round worm which had introduced its head into the ampulla of Vater, allowing a back flow of bile or intestinal juices into the pancreas, or had created such an irritation in the duodenum that the ampulla became closed by the resulting inflammatory reaction.

Novis reports a remarkable case of partial obstruction of the pancreatic duct by a round worm with recovery after surgical intervention. After recurrent attacks for eight days operation revealed an enlarged pancreas which was split open from head to tail. The pancreatic duct was incised and a full-sized living worm and a partially disintegrated worm extracted. The patient made an uneventful recovery.

Eberle's case presented two worms in the pancreatic duct together with great numbers of worms in the common duct, hepatic duct and parenchyma of the liver.

Altman reports the autopsy findings of his case in which the pancreas was markedly increased in size and many worms were found in the duct of Wirsung. Clumps of worms were also found in the tail of the pancreas.

Pfanner also reports a case of acute pancreatitis caused by Ascaris lumbricoides.

*Ascaris in the Bile Ducts, Gall-bladder and Liver.*—The liver, bile passages and gall-bladder have not been immune to the ravages of the round worm. One of us (J.M.G.) witnessed an autopsy performed by Chiari in Vienna on a patient dying of a severe jaundice. The common duct was found packed with worms.

Worms in the gall-bladder, bile ducts or liver present symptoms indistinguishable from stones or other infective processes. Worms within the gall-bladder have presented symptoms not unlike gall-stones. Worms in the bile ducts present symptoms exactly like those produced by stones. Painless, progressive jaundice suggesting carcinoma of the head of the pancreas has been caused by ascaris.

Borger in 1891 found fifty-nine cases of round worm in the bile ducts. Tsujimura in 1922 collected thirty-three cases. Brayne's case was profoundly jaundiced, and at autopsy the gall-bladder, common duct, cystic duct and hepatic ducts were full of worms. On sectioning the liver numerous large worms were found in the ducts. The cut liver presented an extraordinary appearance. Two or three worms were cut across, but some six or eight were peeping out from the cut end of the bile ducts on each side of the incision.

Shim's case is interesting in that the patient, a male of thirty-eight, had had recurrent attacks of pain in the right upper quadrant for six years. At operation a long calculus was found in the common duct. The centre of the calculus contained the ova and remnants of a round worm.

Eberle's case is that of a young boy of nine, operated on because of pain and severe jaundice. A worm was found in the gall-bladder and three in the hepatic duct, all living, and from 20 to 25 centimetres long. Eleven days later two more worms were removed from the bile ducts. This is the first case on record according to Eberle in which an operation was performed for invasion of the biliary apparatus under the age of ten. His second case was a woman of forty-five. At operation six gall-stones were removed, six living ascarides were removed from the common duct, twenty-five from the hepatic duct, thirty-five from the parenchyma of the liver and two from the pancreas. Both the liver and the pancreas were studded with small abscesses.

Degorce reports a case of violent hepatic colics recurring for seven years. At operation many stones were removed from the common duct. The patient recovered but died six months later of pulmonary tuberculosis. Autopsy showed about forty stones in the biliary passages, all of which contained eggs of the round worm. Sectioning one of the largest stones, a filament one and one-half inches long was found which proved to be a small ascaris.

Cases of increasing painless jaundice simulating malignancy of the head of the pancreas have been reported. Merteus and Panayatation report cases of this type without pain, without temperature, but with progressive increasing jaundice which c'eared up spontaneously after expulsion of the round worms.

A number of cases of abscess of the liver have been reported. Kirkland, Dunkel and Leick each report a case of ascaris lumbricoides found within an abscess of the liver. Eberle reports two cases of liver abscess caused by the worms, one a woman of fifty-two and the other a child of seven. The first patient complained of severe pain in the right upper quadrant radiating to the shoulder, septic temperature, nausea, vomiting and jaundice. The liver was palpable. A diagnosis of cholelithiasis was made but at operation a hard mass on the under surface of the left border of the liver was found, which when opened contained pus and worms.

The second case, a girl of seven, complained of severe abdominal pain, pain in the right upper quadrant, septic temperature, but no jaundice. The pre-operative diagnosis

was liver abscess and septic cholangitis. At operation a large mass was removed from the left lobe of the liver. This mass contained considerable pus and many worms. No connection between the abscess and bile passages could be determined. Hartman-Keppel reports two similar cases.

Multiple liver abscesses, varying in size, caused by round worms have been reported by a number of investigators. Altman's case was a little girl of two, complaining of severe abdominal pain and symptoms pointing to a meningitis. At autopsy a pneumococcus meningitis was found. The stomach, duodenum and ileum were filled with balls of worms. The mucosa of the bowel was extremely friable. One worm was found extending into the papilla of Vater. The hepatic duct was full of worms and throughout the ducts of the liver worms were found, the ducts being widened and containing bile pus. Scattered through the liver were small cholangitic abscesses. The pancreas was large, dark and worms were found in the duct of Wirsung, while in the tail of the pancreas clumps of worms were found. The infection in the liver and pancreas was due to bacteria brought in by the worms, together with the widening of the bile passages and retention of secretions.

*Ascariasis in the Gall-bladder* has been reported nine times. Morton has recently collected cases in which the worm was found within the gall-bladder and undoubtedly the cause of the patient's symptoms. A pre-operative diagnosis is impossible—the outstanding symptom being severe biliary colics. In a case reported by Degorce, necropsy showed many stones present within the gall-bladder, all of which contained the eggs of the round worm. On section of one of the largest stones, a filament one and one-half inches long was found which proved to be a small ascaris.

*Appendicitis* due to ascaris lumbricoides is not uncommon, the literature containing many reports of typical attacks which at operation were shown to be caused by the ascaris.

Ludlow reports three cases of perforated appendices with localized collection of worms in the right iliac fossa.

Portly's case had already perforated but was operated before any peritonitis had occurred. The worm was found lying free in the abdominal cavity. Schlössmann reports eleven cases of appendicitis due to ascaris lumbricoides.

Perthes reports six cases of ascaris in the abdomen associated with appendicitis. The appendices were either perforated or gangrenous and the worms were alive. The author conjectures whether the appendicitis was the result of the ascaris or whether both were present at the same time.

*Ascaris in the Fallopian Tube.*—A number of cases of ascaris lumbricoides found in the Fallopian tubes have been reported. Nacken reports a case of pyosalpinx in which he found a worm measuring 25 centimetres. The ileum in this case was firmly attached to the tube and a perforation of the ileum leading to the tube was demonstrated.

Adeodato's case presented the picture of a cystic salpingo-oöphoritis. At operation the cystic tube ruptured and an ascaris 10 centimetres long dropped out. No demonstrable opening between the cystic mass and the intestines was found in this case.

Maxwell reports a tubo-ovarian abscess in which no communication between the bowel and tube could be demonstrated. He feels that the possibility of the worm's passing through the bowel with subsequent closure of the opening must be entertained. He also feels that there is a possibility that the worm might have gone into the vagina, ascended through the uterus and into the tube.

Hofstotter's case is similar to the preceding one. In his case, however, the patient died of a perforated cæcum due to ascariasis. At autopsy a right pyosalpinx was found and a worm 15 centimetres long was found in the left tube, the fimbriated end of which was closed. This proved that the worm did not enter the tube after death, for otherwise the tube would have remained open. That it was impossible for the worm to enter the tube via the rectum, vagina and uterus was ruled out by a very marked stenosis at the uterine end of the tube which would not permit the passage of the finest probe. Hofstot-

ter believes that after the perforation, the worm wandered over to the left tube, as it was impossible to gain entrance into the right side because of a pyosalpinx.

*Ascaris Lumbricoides in the Urinary Bladder.*—We have been able to find only one case report, in recent literature, in which the worms were found in the urinary bladder. Carsten reports such a case occurring in a man of sixty-nine who consulted him because of a twenty-four-hour urinary retention. A catheter was easily inserted and after twenty-four hours was removed because no urine passed through the tube. On removing the catheter the opening was blocked by a 20-centimetre ascaris. No urinary disturbance occurred after the worm was removed. Three days later, the patient again returned because of retention of urine. On insertion of a catheter another worm measuring 10 centimetres was removed. Following this the patient made an uneventful recovery.

Just how the worms gained entrance into the bladder makes interesting conjectures. Did they perforate the bowel and the urinary bladder? Was there a fistula between the bowel and bladder? Did the worms get into the bladder by way of the kidneys? Did the eggs get into the bladder by way of the lymph-stream?

Examination of the urine sediment showed the presence of many eggs. Examination of the bladder showed no defect in the wall. Examination of the rectum failed to reveal evidence of a recto-vesical fistula. Methylene blue introduced into the bladder failed to make its appearance in the rectum. Carsten feels that the logical conclusion is that the ascaris' eggs entered the urinary bladder by way of the lymph-stream.

*Empyema and Pulmonary Gangrene Due to Ascariasis.*—Middleton reports the autopsy findings in a boy of four in which the left pleural cavity contained 500 cubic centimetres of thick pus. The left lung was practically collapsed, the lower lobe airless, firm and brownish green. Two and a half inches of the cephalic extremity of a round worm which measured 14 centimetres in length protruded into the left pleural cavity through a perforation of the lower lobe posteriorly near the hilum. The tract along which the worm had passed could be traced into the lung substance. The worm had apparently been regurgitated from the stomach to the level of the larynx and aspirated into the left bronchus, which it perforated to reach the lung.

Stiles refers to forty cases in which the adult worms have been found in the lungs, causing gangrene and pneumonia.

Wyss reports two cases of pleural effusion in which the eggs of the ascaris lumbricoides were found. The first case is that of a patient with liver abscesses due to ascariasis with perforation into the pleural cavity. The second case is that of a child one and one-half years old. The pus in this case contained many eggs of ascaris lumbricoides. Here the cause of the empyema was not determined.

The round worm has been found in an inguinal ulcer as reported by J. Wiegersma.

Kortzeborn did a resection of the stomach which was followed by death due to peritonitis. At autopsy the abdomen contained a number of worms which had escaped through the suture line and produced the peritonitis.

Blanchard compiled eighty-one cases in which the ascarides escaped through the body wall, twenty-nine through the umbilicus, thirty through the groin, ten at unstated points of the abdomen, two by the hypochondrium, two by the lumbar region, two by an inguinal abscess and one each by the sacral, pubic, perineal region, abscess of the thigh, inferior portion of the thorax and linea alba.

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# SPINAL ANÆSTHESIA

## AN ANALYSIS OF 497 CASES

By Ernest E. Arnheim, M.D., and Sigmund Mage, M.D.

of New York, N. Y.

FROM THE SURGICAL SERVICE OF THE MOUNT SINAI HOSPITAL

The following is a report of the experience with the use of spinal anæsthesia at the Mount Sinai Hospital in New York City for the years 1927, 1928 and 1929. No attempt will be made to discuss the relative value or the physiological aspects of spinal anæsthesia, but we will present our observations in a series of cases over a period of three years. It was the impression of the surgeons of the hospital, gained both from the literature and personal communications, that spinal anæsthesia was receiving an enthusiastic reception without an adequate recording of all the observations attendant with its practice. In this series, spinal anæsthesia was used in selected cases. For the most part, these cases were either those in which there were contra-indications to a general anæsthetic, or those in which the operative procedure, usually abdominal, was of some magnitude.

*Number of Cases.*—497.

| | | |
|---|---|---|
| *Age Distribution.*— | 10-20 years | 7 cases |
| | 20-30 years | 46 cases |
| | 30-40 years | 87 cases |
| | 40-50 years | 139 cases |
| | 50-60 years | 128 cases |
| | 60-70 years | 82 cases |
| | 70-80 years | 8 cases |

*Sex Distribution.*—Male, 327; female, 170.

*Technic.*—In most cases, the individual surgeon acted as his own spinal anæsthetist, the patient being carefully observed throughout the course of the operation by a regular nurse staff anæsthetist.

*Drug Used.*—The drug used was almost exclusively neocaine in crystalline form dissolved in the spinal fluid.

*Dosage of Drug.*—The usual dose of neocaine was 120 milligrams.

*Position of the Patient.*—The lumbar puncture was done with the patient either in the sitting or in the lateral position. Immediately after the injection the patient was placed in slight Trendelenburg position.

*Preliminary Medication.*—Morphine and atropine were administered prior to the procedure in 345 cases, and codeine and atropine in thirteen cases. Ephedrine was given in 145 cases. The usual dose of ephedrine was 50 milligrams.

*Level of Injection.*—The level of injection was specifically noted in only sixty-eight cases. Of these, twenty-seven were administered above the second lumbar vertebra and forty-one below that site.

*Blood-pressure Changes.*—Accurate blood-pressure determinations were recorded in 117 cases. In ninety-nine cases there was a fall in blood-pressure of from 10 to 100 millimetres of mercury. This fall occurred in most cases within fifteen to thirty minutes following the injection of the anæsthetic. Marked drops in blood-pressure (50 millimetres or more) were noted in thirty-five cases. These marked drops in blood-pressure had severe accompanying clinical manifestations in twelve cases, six of whom were over sixty years of age, and nine of whom were over fifty years of age. In all cases in which a fall in blood-pressure was observed, ephedrine had been used prior to induction. In eighteen cases there was a rise in blood-pressure which was maintained above the ante-operative blood-pressure throughout the course of the operation. The rise in most cases was within the first ten minutes. Ephedrine had been used in sixteen of these eighteen cases.

No relation could be determined between the changes in blood-pressure and the level of the injection. Striking falls in blood-pressure were observed as frequently in injections below the second lumbar vertebra as in those injected above that level.

*Adequacy of Anæsthesia.*—The anæsthesia was considered adequate throughout the operation in 326 cases—65.6 per cent. No supplementary anæsthesia was used in this group. In these cases the duration of the operation was as follows:

| No. of Minutes | No. of Cases |
|---|---|
| 0-10 | 4 |
| 10-20 | 26 |
| 20-30 | 38 |
| 30-40 | 54 |
| 40-50 | 43 |
| 50-60 | 25 |
| 60-70 | 27 |
| 70-80 | 27 |
| 80-90 | 23 |
| 90-100 | 13 |
| 100-110 | 8 |
| 110-120 | 6 |
| 120-130 | 4 |
| 130-140 | 3 |
| 140-150 | 1 |
| 160-170 | 2 |
| 180-190 | 1 |
| 200-210 | 1 |
| 210-220 | 2 |

It should be noted that this is not an absolutely accurate record of the actual length of anæsthesia. In the very short operations, the anæsthesia was usually of longer duration, and in some of the very long cases the anæsthesia had partly worn off toward the end of the operation even though no supplementary anæsthesia had been given.

There were eighteen cases in which the anæsthesia was satisfactory but in which the duration of the operation was not recorded.

The anæsthesia was entirely unsatisfactory in eight cases (1.6 per cent.). In three of these it appears that the technic of injection was faulty. In a few cases, the exact number not known, there was noted a lack of relaxation of the abdominal wall, although the patient appeared to suffer no pain.

The spinal anæsthesia had to be supplemented in 163 cases (32.8 per cent.). In sixty-four of these, the exact time at which the supplementary anæsthesia was begun was noted.

| No. of Minutes | No. of Cases |
|---|---|
| 10-20 | 2 |
| 30-40 | 8 |
| 40-50 | 7 |
| 50-60 | 9 |
| 60-70 | 8 |
| 70-80 | 10 |
| 80-90 | 7 |
| 90-100 | 6 |
| 100-110 | 4 |
| 120-130 | 3 |

*General Condition of the Patient before Operation.*—A large variety of medical complications was found in the group of patients under consideration. The most outstanding of these were:

| | No. of Patients |
|---|---|
| Arteriosclerosis | 61 |
| Myocardial and valvular lesions | 28 |
| Pulmonary tuberculosis | 15 |
| Chronic bronchitis and emphysema | 65 |
| Anæmia (hæmoglobin below 60 per cent.) | 61 |
| Obesity | 30 |
| Diabetes | 10 |
| Nephritis | 4 |

*Nature of Operation.*—The types of operation in this series of cases were as follows:

| | |
|---|---|
| Stomach (126 gastrectomies) | 154 |
| Intestinal (including appendicectomies) | 94 |
| Liver and biliary passages | 72 |
| Hernioplasties | 60 |
| Exploratory laparotomies | 39 |
| Kidney and bladder | 39 |
| Rectal and recto-sigmoidal resections | 26 |
| Extremities (lower) | 8 |
| Gynæcological | 3 |
| Splenectomies | 2 |

*Untoward Reactions.*—In this series of cases, untoward symptoms of a transitory nature, *i.e.*, nausea, vomiting, shallow respirations, which had no effect on the patient's condition or the efficacy of the anæsthesia, were not accurately enough observed to be recorded. Instances of more pronounced reactions were observed in twelve cases. These reactions were evidenced chiefly by the signs and symptoms of shock.

*Complications.*—Which were directly attributable to the spinal anæsthesia were: 1. Aseptic meningitis, one case; 2. Pyocyaneus meningitis, one case; 3. Transverse myelitis, one case. Complications in which spinal anæsthesia was possibly contributory:

1. Suppression of urine, two cases.

Suppression of urine is probably the result of marked drops in blood-pressure in patients with long-standing hypertension. The kidneys which are accustomed to secrete at a high pressure fail to secrete at such a low level.

2. Vascular complications.—a. Phlebitis, four cases; b. Hemiplegia, three cases.

It is difficult to state how much of a rôle spinal anæsthesia plays in the incidence of vascular complications. We do not know what the incidence of vascular complications would be in a similar series of cases of general anæsthesia. It is possible, that with the usual drop in blood-pressure and slowing of the blood-stream, thromboses would be relatively more frequent.

*Pulmonary Complications.*—1. Pneumonia, twenty-one cases; 2. Pulmonary infarct, two cases; 3. Pulmonary emboli, two cases.

The high incidence of pneumonia, twenty-one cases (4.2 per cent.), was somewhat of a surprise. These pneumonias were all verified either by X-ray or post-mortem examination. We soon learned that spinal anæsthesia did not prevent post-operative pulmonary complications.

*Deaths.*—Deaths which were undoubtedly due to spinal anæsthesia: 1. Pyocyaneus meningitis, one case, case No. 306234 above; 2. Transverse myelitis, one case, case No. 300122 above; 3. Spinal anæsthetic shock, one case.

In this last case, Hosp. No. 306931, the patient was a woman, sixty-nine years of age, who was admitted with a three-day history of generalized abdominal pain gradully localizing into the right lower quadrant. There were no similar previous attacks. Physical examinations showed an obese woman with general signs of senility, but who seemed to be in good general condition. There was deep and rebound tenderness over McBurney's point, and rectal tenderness on the right side. The blood-pressure was 134/90. A spinal anæsthesia was given, 120 milligrams of neocaine between the first and second lumbar vertebræ. Five minutes after the operation had started, the patient ceased breathing and the pulse could not be obtained. In spite of all restorative measures—intravenous, cardiac massage and intracardiac adrenalin—she did not respond. There was no post mortem examination.

Deaths in which spinal anæsthesia was possibly a contributory cause:

1. A case of partial colectomy for carcinoma of the colon, operation lasting over two hours.

2. A seventy-eight-year-old man subjected to amputation through the mid-thigh for arteriosclerotic gangrene of the foot. Condition became poor soon after injection of spinal anæsthetic. Duration of operation, eighteen minutes; death at end of twenty-four hours.

3. Case of suppression of urine cited above under the heading of complications.

4, 5, 6. Three cases of hemiplegia, which came on one and three days after operation. The patients died three, seven and ten days after operation.

Deaths undoubtedly not due to spinal anæsthesia—seventy-three.

## SUMMARY

1. This series of 497 cases of spinal anæsthesia was, for the most part, a selected one, spinal anæsthesia being used in cases in which there was a contraindication to general anæsthesia, or cases in which the major operative procedures, usually abdominal, could be more easily carried out. We hope to report a more representative series in the future.

2. No relation could be determined between the changes in blood-pressure and the level of injection of the anæsthetic (usually neocaine in the dosage of 120 milligrams).

3. There was no anæsthesia in eight cases (1.6 per cent.).

4. The number of cases in which the spinal anæsthesia had to be supplemented by general anæsthesia was 163 (32.8 per cent.). We have more recently found that the number of supplementary anæsthesias can be cut down by using larger doses of the drug, neocaine.

5. Pronounced reactions on the operating table, which were evidenced chiefly by the signs and symptoms of shock, occurred, for the most part, in patients in advanced years who showed evidences of arteriosclerosis and myocardial disease, or in those cases of cachexia or intoxication from some debilitating disease.

6. Cases of hypertension may develop suppression of urine as a result of marked drops in blood-pressure when not overcome.

7. There was a relatively high incidence of post-operative pneumonias—twenty-one cases (4.2 per cent.).

8. There was one toxic spinal anæsthetic death (0.2 per cent.) the other two deaths being due to errors in technic which are avoidable.

*Conclusion.*—Spinal anæsthesia is an excellent anæsthesia because of the great technical advantage to the surgeon and the relatively little upset of general body metabolism, but its dangers should be clearly understood, and its indiscriminate use discouraged.

# TRANSACTIONS

OF THE

# NEW YORK SURGICAL SOCIETY

STATED MEETING HELD NOVEMBER 12, 1930

The President, Dr. Edwin Beer, in the Chair

## CONGENITAL ABSENCE OF SIGMOID AND RECTUM, COLOSTOMY

Dr. Seth M. Milliken presented a child five years of age who was born at 8 P.M. October 11 and first seen by him about 10 A.M. October 12, 1925. The child seemed normal except for absence of anus. At the anal site there were two projecting skin tabs but no perforation of the skin. There seemed to be some impulse against the perineum when the baby cried. A scalpel was introduced with no result and finger inserted between tuberosities failed to palpate descending bowel. Pelvis apparently empty. A weak barium mixture was taken in teaspoon doses every two hours for twelve hours. X-ray October 13 showed normal small intestine with barium as far as the cæcum and gas distending the large intestine as far as a smooth caput implanted in the left iliac fossa. Colostomy was then (October 13) performed through the left rectus. Finger inserted found lower extremity of descending colon completely closed and attached to left iliac fossa. The sigmoid and rectum were absent. The baby was sent home two days after operation and has made satisfactory progress to the present.

There is now herniation of the descending colon mucosa of about 2½ inches; the colostomy ring is slightly large. Finger may be inserted distally to the iliac fossa. The boy has not yet learned to regulate evacuations and the moisture from blind end is annoying.

Dr. Henry W. Cave remarked that at times it is exceedingly difficult to determine the exact site of the atresic band even though the anus be present and not merely a dimpling. It is difficult to determine whether the obstruction from the atresia is in the large or small bowel, as usually the child is so young and the distention so marked. Where there is a doubt, a small amount of barium may be instilled into the rectum, and then take X-rays. A catheter inserted into the rectum to see whether it is patent as far as the sigmoid gives often unreliable information. A few years ago a child four years of age was referred to him from the Nursery and Childs Hospital with complaint of obstipation, nausea and vomiting since birth. The father had tried unsuccessfully to give it an enema. It was then taken to the Nursery and Childs Hospital where two internes had tried to insert a No. 20 French catheter but this was admitted only to 6 centimetres. The child was then brought from the Nursery and Childs Hospital to the Roosevelt Hospital where three of the interne staff and two of the attending staff attempted unsuccessfully to insert a French catheter up into the bowel. The insertion of the little finger was stated to have divulged a blind pocket of the rectum so

that an atresic band was thought to exist somewhere in the recto-sigmoid or sigmoid. However, to the surprise of everyone when a left rectus incision was made there was no absence of the sigmoid nor even an atresic band of the sigmoid, but there was found an atresic band about 4 inches in length and about the size of an ordinary shoe lace in the last portion of the ileum. An ileostomy was immediately done. The child made a satisfactory recovery from this first operation and sixteen days later—after a barium enema had shown the patency of the large bowel—an ileocolostomy was done; the ileum proximal to the ileostomy wound was anastomosed to the transverse colon. The child, however, died four days later from a broncho-pneumonia. An autopsy revealed: Bilateral broncho-pneumonia, the ileocolostomy anastomosis secure and no evidence of peritonitis.

Dr. Frederic W. Bancroft said that the finding of a gas bubble in the terminal segment is often of considerable value. In two cases in which he had waited thirty-six hours after birth for an X-ray, by placing a metal indicator on the anal dimple and observing the bubble of gas in the terminal bowel segment it was possible to gain some idea of the distance between the two by a lateral X-ray plate. It was necessary in one case to raise the buttocks, in order to aid gravity. While in many cases it may be necessary to do a laparotomy to determine the procedure, in the cases where the bubble and the indicator are near each other this procedure may be avoided.

## OBLIQUE FRACTURE, MIDDLE FEMUR: TRACTION SUSPENSION

Dr. Seth M. Milliken presented a man, thirty-six years of age, who was brought to the French Hospital after having been struck by a taxicab. He was admitted at 10.30 P.M. November 14, 1929. Besides a slight scalp wound there was a fracture of the left thigh with shortening of 3½ inches, the fragments projecting under the skin.

Suspended traction with Thomas splint and Pierson leg piece, knee in 90 degrees flexion, was immediately applied with a total of 43 pounds, traction weight (Fig. 1). X-ray following morning (Fig. 2), showed good reduction which gradually improved. Weight diminished as soon as fragments were in alignment, which occurred the fourth day. Union prompt, function slowly regained. Was discharged walking on crutches March 28, 1930, able to bear full weight on that side. Last seen October 17, 1930, at which time he had resumed his usual occupation and was walking without limp. Measurement showed no difference in two extremities (Fig. 3).

Doctor Milliken said he was presenting this patient to explain the purpose of the flexed knee traction in fractures of the femur. By flexing the knee the distal part of the quadriceps muscle is drawn downward so that any part of the muscle which may have been engaged on the proximal fragment is freed and the bone ends thus cleared may engage with the distal fragment which by the traction is aligned with the proximal fragment both by the direction of pull and by the compression of the encasing muscles. Traction with the leg in extension does not thus relax the distal portion of the quadriceps and interposition of soft parts is less easily avoided. The elevated

foot of the Gatch bed gives the patient a firm and comfortable counter pressure point making the full force of the weight exert traction on the lower fragment without displacing the patient. Pressure on the back of the calf is relieved by extending the leg from time to time, which should not be done until perfect reduction has been accomplished. The posterior half of the Thomas ring is unnecessary and may be a source of danger as the upper fragment will rest upon it and be thrown forward into a flexed position making it necessary to elevate the distal fragment an undue amount. Without the posterior half of the ring the upper fragment rests on the mattress, all counter pressure being borne by the buttocks. If the reduction by attachment to the skin only is not complete tongs are promptly attached to the

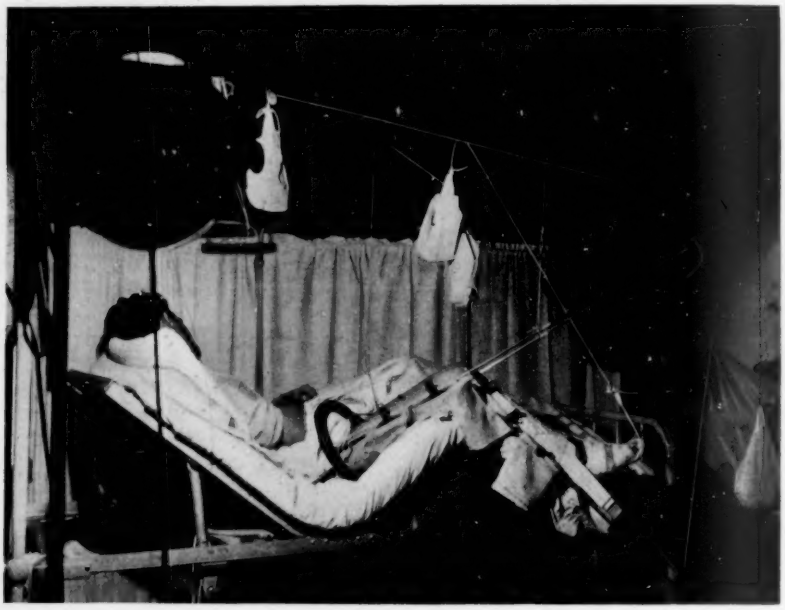

FIG. 1.—Illustrating suspended traction for supracondylar comminuted T fracture. The flexed leg with the traction on the lower end of the Thomas splint accomplishes the reduction. Voluntary motion is allowed as desired.

condyles, which avoids any danger of skin necrosis at upper part of leg. It is particularly important to apply adequate weight at the outset so that the muscles may be stretched before they have become contractured.

DR. KIRBY DWIGHT said he had used this method of traction in a number of cases, and the results had been very satisfactory and he had considerable confidence in it. He did not rely, however, entirely on skin traction or pressure against the back of the calf. He preferred to use skeletal traction on the lower end of the femur and skin traction on the leg. The great advantage of this form of treatment lies in the fact that the patient can have first passive and later active motion of the knee-joint, without altering the tension at the line of fracture, and consequently with much less pain. That is the principal advantage, and the second is that skin traction on the leg is much

more effective when direct pressure on the calf of the leg is used to supplement it.

Doctor Milliken, in closing the discussion, said that he also put in tongs or a nail if there was difficulty in obtaining reduction of over-riding. If skin traction did not reduce the over-riding in twenty-four hours, skeletal traction was put on.


Fig. 2.—Lateral view after twelve hours' traction showing correction of 8½ inches over-riding, at which time weight was reduced to 25 pounds.


Fig. 3.—Lateral view showing good weight-bearing alignment with small callus.

## THE RELATION OF THE WELCH BACILLUS TO APPENDICITIS AND ITS COMPLICATIONS

Dr. John E. Jennings read a paper with the above title for which see page 828.

Dr. Frank L. Meleney remarked that four years ago a group on the surgical staff of the Presbyterian Hospital undertook to study the problem of peritonitis because of its extreme surgical importance. They were naturally greatly interested in the work of Williams and Heyde and others whom Doctor Jennings has mentioned and read with interest his own publications and those of Weinberg which appeared two years ago. Their chief criticism of the bacteriology in these reports is that cultures were made from the lumen or the wall of the appendix which was removed at operation and conclusions

were drawn from these findings. It would have been more to the point to study the peritoneal fluid, a part of which is always left in the abdominal cavity after operation. They made cultures of peritoneal fluids and then tried to correlate their findings with the clinical aspects of the case both before and after operation. In their laboratory work, although they tried to have no preconceived notions, they laid particular stress upon recovering the anaërobes because of their prevalence in the intestinal tract and because of the emphasis placed upon them by recent workers. An anaërobic technic was used which they have found satisfactory in culturing the well-known anaërobes and believe that their results with regard to B. welchii approximate closely the incidence of that organism in the peritoneal exudates of their cases. He would confine himself to that portion of their data which pertains to the significance of B. welchii.

I.—Their series included 106 cases of peritonitis of which 76 were due to appendicitis and 30 to other causes. Seventy-one of these cases yielded one or more specimens of bacteria. B. welchii occurred twenty-seven times or 38 per cent. It never occurred alone. It was always in association with other organisms and it was much more common when many different species were present, than when only two or three species were present but the percentage of mortality in these two groups was exactly the same. In the smaller group B. coli was five times as common and the green streptococcus twice as common as B. welchii; while in the prolific group B. welchii more nearly approached the others. These three were the organisms most commonly found. See Table I.

TABLE I

| | Number of species cultured | | |
|---|---|---|---|
| | None | 1–3 | 4–6 |
| Total number cases | 35 | 40 | 31 |
| Non-hæm. B. coli | — | 32 | 30 |
| Green strept | — | 14 | 21 |
| Hæm. B. welchii | — | 6 | 21 |
| Mortality | 0 | 22% | 22% |

II.—The correlation of the bacteriological findings with the clinical course was more significant when the cases were divided into three groups according to the extent of peritoneal involvement. The only features specially notable in this connection are the percentage incidence of the organism and the percentage mortality in each group. Table II shows that the percentage of incidence, as well as mortality, with B. welchii was almost always less than with the other two common organisms.

III.—When the occurrence of these organisms in cases of appendicitis was compared from the standpoint of the severity of symptoms on admission,

TABLE II

| | Percentage | | | | | |
|---|---|---|---|---|---|---|
| | B. coli | | Green strept. | | B. welchii | |
| | Incid. | Mort. | Incid. | Mort. | Incid. | Mort. |
| Acute local peritonitis | 28 | 0 | 11 | 0 | 13 | 0 |
| Acute diffuse peritonitis | 75 | 28 | 42 | 17 | 31 | 17 |
| Peritoneal abscess | 96 | 17 | 65 | 13 | 44 | 4 |

the number of post-operative complications and the mortality, it was found that those cases yielding B. welchii were not appreciably sicker on admission and had only a slightly greater number of complications. The mortality was exactly the same as in the B. coli group and definitely less than in the streptococcus group. See Table III.

TABLE III

| Total number | B. coli | | Green strept. | | B. welchii | |
|---|---|---|---|---|---|---|
| | 46 | | 24 | | 15 | |
| | No. | % | No. | % | No. | % |
| Moderately ill | 37 | 80 | 19 | 79 | 11 | 73 |
| Severely ill | 9 | 19 | 5 | 21 | 4 | 27 |
| Few complications | 38 | 82 | 20 | 83 | 11 | 74 |
| Many complications | 8 | 17 | 4 | 17 | 4 | 26 |
| Recovered | 40 | 87 | 19 | 79 | 13 | 87 |
| Died | 6 | 13 | 5 | 21 | 2 | 13 |

In this table, of course, there is overlapping of cases because of the simultaneous occurrence of these organisms.

IV.—The difference between a monomicrobic and a polymicrobic infection is seen when combinations of these organisms are compared with one of them alone. B. coli was the only one of these three which occurred alone. The conditions were very much worse when the other organisms were present also. Although the presence of B. welchii may have been a factor in increasing the estimate of the severity of the illness before operation, it did not increase the mortality at all. See Table IV.

TABLE IV

| | Totals | Severity | | Result | |
|---|---|---|---|---|---|
| | | Mod. | Grave | Recov. | Died |
| B. coli alone | 9 | 89% | 11% | 100% | 0 |
| B. coli and g. strept. without B. welchii | 26 | 81% | 19% | 69% | 31% |
| B. coli and g. strept. with B. welchii | 22 | 55% | 45% | 73% | 27% |

V.—When the different types of appendicitis are compared to estimate their relative importance it is found that the acute appendicitis cases with acute local peritonitis but without perforation were mild, had few sequelæ and all recovered, although two of these cases yielded B. welchii. When there was gangrene without perforation, likewise the cases were mild, had few sequelæ and all recovered. In these cases B. welchii was never found in the peritoneal exudate, suggesting that while it may have played a part in the production of the gangrene it did not pass through the wall and multiply in the peritoneal cavity. When perforation occurred, large numbers of different species of bacteria were cultivated from the fluid. B. coli was found in every case but B. welchii in less than half of them suggesting either that it was not present in the lumen (which is not likely) or that it could not maintain itself in the peritoneal cavity. In this group, B. welchii occurred more than twice as many times in the abscess cases as in the diffuse cases but the mortality was greater in the latter group. These points are brought out in Table V.

TABLE V

| | Ac. inflam. without perforation | Gangrene without perforation | Perforation: diffuse peritonitis | Perforation with abscess |
|---|---|---|---|---|
| Number of cases | 31 | 8 | 11 | 12 |
| Moderately ill | 31 | 8 | 6 | 9 |
| Severely ill | 0 | 0 | 5 | 3 |
| Few complications | 31 | 8 | 2 | 11 |
| Many complications | 0 | 0 | 9 | 1 |
| Recovered | 31 | 8 | 8 | 10 |
| Died | 0 | 0 | 3 | 2 |
| B. coli | 5 | 5 | 11 | 12 |
| Green strept | 2 | 2 | 6 | 9 |
| B. welchii | 2 | 0 | 3 | 7 |

When lesions of the small and large gut were considered it was found that B. welchii were present in all three cases of perforated ileum and all were fatal. It was likewise present in all of the five cases of perforated colon and all but one recovered. This patient was almost moribund on admission. This suggests that it is not so much the nature of the organisms as the dosage of these organisms or the presence of irritating intestinal juices that determines the fatal outcome.

When viewed from every angle, these studies seem to show that the severe cases of peritonitis are polymicrobic, that B. coli, green streptococcus and B. welchii are the commonest organisms present. The importance of any one of these species, in the series, seemed to depend more upon its prevalence than upon its virulence. All of the evidence seemed to show that B. welchii *per se* did not materially increase the severity of the disease or increase the chance of a fatal outcome.

When they began this study, they gave serum to unselected cases yielding B. welchii. Two out of five, or 40 per cent. died. As soon as these results

began to be apparent, the use of serum was given up. Of the untreated twenty-two cases yielding B. welchii, five died or 23 per cent.

They do not believe that B. welchii antitoxin is going to be the solution of the problem. They believe that the only hope of further success, aside from earlier operation, lies in a study of the symbiosis of these bacteria and the rôle played by the intestinal digestive juices and the fæcal foreign bodies.

Dr. Henry H. M. Lyle remarked as to the use of serum for gas gangrene, that undoubtedly the serum has been improved since the war. In the early years he was in charge of the hospital in which some of the original work referred to was carried on and where many tests of the serum were made. No apparent results were obtained. In the later years of the war with supposedly improved serum he still was unconvinced of its value.

The mere finding of B. welchii in a wound does not necessarily imply a severe gas gangrene; it was often found in war wounds which ran a mild course. Other factors such as the associated bacteria, the condition of the tissues, the blood and nerve supply were as important factors in determining the severity of the case as the presence of B. welchii. It was often found in wounds but rarely in the blood. Yet at autopsy gas infection of liver and other organs were found. Doctor Lyle has an impression that it was in the circulation more often than the laboratory reports would indicate.

Doctor Lyle, in 1916, showed before the surgical section of the Academy of Medicine a specimen of heart and liver tissue infected with gas bacilli with the absence of local infection. This French soldier had been wounded on the left thigh by a shell fragment. At the time of the entrance to the hospital the patient had a perforating wound of the upper left thigh. The wound was débrided and Carrel treatment started—no shell fragment was found. The patient insisted that the fragment had not been removed at the front. X-ray at level of anterior-superior spine showed no foreign body. The wound remained clean and no bacteria were found in the smears. On the third day the patient began to show evidence of a generalized gas infection—no local signs—on the fourth day he died suddenly. At autopsy a clean closed wound of the right femoral vein was found. In the right ventricle a small shell fragment was found. Attached to it was a portion of the uniform. The shell had entered the femoral vein and migrated to the right ventricle. The source of the blood infection was the small portion of the uniform attached to the shell. The heart with shell fragment in place was sent to the Army Medical Museum. This was the first case on record of migration of shell fragment to the heart. The Grandgerara case was a shrapnel bullet which, although reported before the above case, happened after it.

Dr. Robert T. Morris said that his feeling in regard to the serum was like that of Doctor Lyle. Doctor Morris also considered that it was very difficult to tell which of the invading microörganisms is the dominating one, unless one made cultures, as Doctor Jennings did and as they did at the Presbyterian Hospital, in order to determine the relative virulence of each

strain. Unless one does that, it is difficult to decide their relative importance. Many years ago the speaker called attention to the fact that surgeons were overlooking anaërobes in making examinations of cases of peritonitis. That was probably because the methods now prevailing for finding them were not then in use. Nowadays one who goes after any particular bacterium finds it by special methods. The question of whether Welch's bacillus is present in these cases or not is of small importance, compared with the basic causative fact that there is invasion of the terminal artery of the appendix or of its branches. When these are plugged with the exudate of endarteritis, the circulation of the appendix is cut off partly or wholly, and any bacteria that come along will get in their work. The extent of plugging of the terminal artery determines the degree of gangrene as a rule. A microbe capable of causing gangrene may be nothing more than a saprophyte in a given case. Consequently a serum made from that microbe would have a highly speculative place in the treatment of appendicitis—might do harm.

Dr. John Douglas said that Doctor Jennings' paper and the remarks of Doctor Meleney and Doctor Lyle seemed to him to indicate that it depends more on whether these anaërobes are growing and are toxic, than whether they are present in cultures of the appendix. He remembered operating on a case a few years ago in a woman fifty-three years of age for abscess of the appendix. There was no reason why she should not have got well on drainage, but she developed a particularly extensive gangrenous infection of the abdominal wall. This was shortly after Doctor Jennings had first reported some of his cases treated with serum. Doctor Douglas gave his patient perfringens antitoxin and firmly believed that he thereby saved her life. Doctor Douglas cited another case which illustrated his idea of the lack of value of culturing for anaërobes in a fulminating case. The operation was a gastric one. The man, apparently doing well, became very ill and died in thirty-six hours. The wound showed gas bacillus infection and the peritoneal cavity and liver were full of Welch bacilli.

Dr. Seward Erdman said he was sure that surgeons cannot be entirely satisfied with the present results of surgery for appendicitis. The patients die too frequently. The general percentage of mortality is 10 per cent. for the acute cases, and somewhere between 5 per cent. and 10 per cent. is the average mortality from the best hospitals. That is nothing to be proud of. And yet this evening, listening to the general discussion, one got the impression that this must be accepted and cannot be changed. But the speaker was optimistic. He believed that some method will be evolved which will help these patients. Consequently he was very glad to hear Doctor Jennings looking forward and holding out hope that one more method may be added to our armamentarium, that will be helpful and will lower the mortality. The work done at the Presbyterian Hospital would seem to negative the claim of Doctor Jennings, but one cannot but believe that there are cases in which the serum should be given a fair trial.

Dr. Charles L. Gibson remarked that he had been interested in the possibility of reducing the appendicitis mortality, even to a very slight extent, by advocating some such treatment as that described by Doctor Jennings, especially anti-gangrenous serum. There is a very general skepticism against vaccines and antitoxins, and the speaker himself had been apathetic until he learned from Doctor Michel, of Nancy, France, that he had reduced the mortality about 40 per cent. in cases of gangrenous peritonitis, by the use of the antitoxin which was furnished by the Pasteur Institute. The last time Doctor Gibson went abroad he obtained some of this vaccine, but found it could not be imported. In the use of it on his service at the New York Hospital, he had encountered the same skepticism. His assistants would not use it. Even if the serum saves only one life in a thousand, that would be worth while. Personally, the speaker believed the treatment was valuable.

Dr. Walter A. Sherwood stated that his own experience in the use of perfringens serum in similar conditions had been limited to about a dozen cases. In these it had been used more or less empirically and without the aid of complicated bacteriological studies. It had been used by him on the basis of clinical observation only and it was impossible to evaluate the results in such a small series of cases. Several of the patients had severe serum reactions. A practical difficulty is the present expense of this product as supplied by the drug firms and commercial laboratories.

Dr. John F. Connors said that he had had considerable experience with the use of serum during the war in France and he came home with the idea that its value in the treatment of gas infections was questionable. However, after reading the article by Williams, of London, about the use of serum in cases of appendicitis with perforation and peritonitis as well as in cases of intestinal obstruction he thought it was worth a trial. The serum for this trial was supplied by the Lederle Laboratories. It was used in twelve cases of perforated appendix with peritonitis and all these patients recovered. It was tried in eight cases of intestinal obstruction without a mortality. The question, however, arose among the staff as to what part early operation and spinal anæsthesia played, as it undoubtedly played some part. The one great obstacle is the high cost and in a municipal hospital it is difficult to get the city to purchase the serum. The mortality in appendicitis with perforation and peritonitis is still too high and if this serum can be added to the facilities for helping to reduce this mortality, it is too valuable an adjunct to be overlooked.

Doctor Herzfeld, of Buenos Aires (by invitation), said that vaccine had been used in his hospital as a routine measure in all cases of gangrenous appendicitis for the last three years, and they had found it very satisfactory. It was manufactured by a dependency of the Government, and it was used in doses of 30 cubic centimetres diluted in 250 cubic centimetres normal saline solution injected at one time. This dose is repeated in twelve-hour

intervals if and as symptoms require. The mortality since the institution of its use had been greatly reduced.

Doctor Jennings, in closing the discussion, said that after ten years' intensive use of the only serum obtainable, it had been felt that there were a sufficient number of successes to justify going on with its use in cases equally in jeopardy. The speaker did not criticize Doctor Meleney's excellent report of the work done at the Presbyterian Hospital, but wished to point out that if he would study the article of Weinberg, published in 1928, who carried this work further, he would probably elaborate his technic as Weinberg has done. Weinberg has done the same work with fuller elaboration and has come to the conclusion that this serum is very useful. The whole article will help to clarify the situation, as will the work of Michel. The way in which Doctor Jennings attempted to attack this problem was as follows: Without a complete anaërobic laboratory, the best thing to do is to look for one or two or three bacteria and attempt not to miss the tree on account of the forest. No attempt is made to make a census of the flora of the intestine of the case, which few laboratories are able to accomplish, but an effort is made to see if one thing can be found which can be recognized. That can be done with the simple guinea-pig technic. Only by that means of attacking the essential organisms in the large intestine, one at a time, will it be possible to come to any real opinion of their rôle. American serum has been found very useful in severe cases, if like any other serum it be given early and enough be given. The speaker did not know whether antitoxin was invariably useful, but if it be used early in cases where the Welch bacillus is recognized, it will cut down the mortality.

### STATED MEETING HELD NOVEMBER 26, 1930

### The President, Dr. Edwin Beer, in the Chair

### BLEEDING DUODENAL ULCER: PARTIAL GASTRECTOMY

Dr. Richard Lewisohn presented a man who at the time of his admission to Mt. Sinai Hospital, June 3, 1926, was forty-nine years old. This patient had been suddenly seized five days previously with a feeling of faintness and vomited a large amount of blood. His condition had become gradually worse. Preceding this attack he had had a long history of epigastric distress which was relieved by bicarbonate of soda. He was often nauseated. His stools during the last few days were tarry. On admission his blood-pressure was 85/48 and his hæmoglobin 20 per cent. An immediate citrate transfusion was given and another was given about twelve hours later. During the four days following these two transfusions his hæmoglobin rose to about 40 per cent. He was placed on a Sippy diet, his condition gradually improved, but his hæmoglobin did not go up beyond the figure quoted. A pre-operative transfusion was given on July 12 and a partial gastrectomy (Billroth II with Hofmeister anastomosis) was performed July 14. The ulcer, which was situated in the first part of the duodenum about 2 centimetres beyond the pylorus, was removed with the distal half of the stomach. The specimen showed an ulcerated area in the first part of the duodenum with

an open vessel at the bottom of the ulcer. This open vessel evidently had caused the bleeding. In addition to this a diverticulum was present just below the ulcerated area. The patient made an uneventful recovery and has gained 30 pounds since his operation. He still has considerable acidity in his stomach, his curve going up to 60 for free acid and to 76 for total acidity. He feels perfectly well.

## BLEEDING DUODENAL AND GASTROJEJUNAL ULCER: SUBTOTAL GASTRECTOMY (FINSTERER OPERATION)

Doctor Lewisohn presented also a patient who was first admitted to Mt. Sinai Hospital in 1918. A gastro-enterostomy was then performed for a duodenal ulcer by another surgeon. The patient felt perfectly well up to seven weeks previous to his second admission in 1923. He then experienced attacks of pain about three hours after his meals. Two days previous to his admission he had a very severe attack of pain. At the time of his second admission he had free acidity of 33, and total acidity of 60. Five days after his admission to the hospital he suddenly felt dizzy and his stools contained a large amount of blood. His hæmoglobin dropped to 29 per cent. A citrate transfusion was given and the hæmogoblin rose to 43 per cent. The X-ray which had been taken three days previously, before the hæmorrhage started, showed a gastrojejunal ulcer with a large residue in the stomach, even after nine hours. He was explored by the same surgeon who noted the following findings: "The stomach was adherent, dilated and could not be delivered. An infiltrated mass was felt at the site of the stoma, probably a gastrojejunal ulcer. A small, hard mass was felt near the pylorus about 1 centimetre in diameter apparently with a crater. The pylorus was adherent to the gall-bladder. This adhesion was carefully divided and a small piece of tissue in this area was excised for pathologic examination. The opening in the intestine was closed with Pagenstecher and omentum was sewed over it. Pathologic examination of the specimen showed œdematous connective tissue and normal intestinal mucosa."

Another transfusion was given immediately after the operation. The hæmoglobin dropped from 43 per cent. to 18 per cent. Another transfusion was given January 12, 1923. The bleeding gradually stopped and an attempt was made to treat this patient medically after the wound had healed by primary union. He left the hospital March 8, 1923.

On September 3, 1923, he was readmitted stating that his symptoms recurred about one week before his readmission. On the day of readmission he vomited about 8 ounces of dark red blood. At this time his hæmoglobin was 25 per cent. Two days later it had dropped to 20 per cent. and a citrate transfusion was given. However, the bleeding persisted and the patient appeared in a most desperate condition. He was pale and was so weak as to be unable to sit up in bed. After another transfusion by the Unger method the patient was operated on September 15, 1923. A large, hard, indurated gastrojejunal ulcer, the size of a silver dollar, completely surrounding the gastroenterostomy stoma was found. The stomach was large and hypertrophied. A crater ulcer was felt between the first and second parts of the

duodenum which was very adherent to the pancreas. The stomach and duodenum were adherent to the gall-bladder and liver. The adhesions between the duodenum and gall-bladder were divided. The duodenum appeared to be quite movable in all parts, except at the base where the ulcer described above was adherent to the head of the pancreas. By careful dissection the gastroenterostomy stoma was entered and the jejunum was separated from the stomach. The opening in the jejunum was closed in two layers. The ulcerated area in the gastroenterostomy stoma was carefully dissected away from the colon, to which it was very adherent. The patient's condition at this time was not good. The pulse was so rapid as to be imperceptible at times. It was thought that removal of the duodenal ulcer would necessitate considerable manipulation of the pancreas and would be followed by marked shock and so it was decided to perform the Finsterer type of subtotal gastrectomy, removing the stomach with the gastrojejunal ulcer, dividing the stomach just beyond the pylorus and leaving the ulcer of the duodenum *in situ*. In order to expedite the operation a Murphy button was used for the anastomosis between the stomach and jejunum. The patient made a good recovery from this operation aside from a partial paralysis of the right arm which subsided under electric treatment. He left the hospital October 29, 1923. He has been perfectly well since his operation and has gained 50 pounds in weight. An Ewald test meal in 1926 showed free acid 0, total acidity 20.

## PROSTATECTOMY IN A NONAGENARIAN

Doctor Lewisohn presented a man, ninety-four years of age, who had been admitted to Mt. Sinai Hospital in September, 1928, with an acute suppurative tenosynovitis and which required multiple incisions. While the patient was in the ward he developed an acute urinary retention which was improved by repeated catheterizations. Rectal examination showed a large prostate. In view of the patient's age operation was not deemed advisable and the patient was sent home. He returned three days later with a marked acute urinary retention. His blood urea was 18. He was treated with a permanent catheter for about one week. A bilateral vasectomy was done September 27, 1928. One week later the first stage of a suprapubic prostatectomy was performed under local anæsthesia. One week after the suprapubic drainage, the prostate was removed under sacral and parasacral anæsthesia. The patient made a perfect recovery and is in perfect health at present, two years after the operation.

Doctor Lewisohn stated that this case was shown in order to demonstrate that even in very advanced age prostatectomy can be performed with great benefit to the patient. Doctor Lewisohn stated further that although he had not looked up the records he thought that this was probably the oldest patient ever subjected to a prostatectomy at Mt. Sinai Hospital.

## RESULTS IN SUBTOTAL RESECTION OF THE STOMACH

Dr. Thomas H. Russell presented four cases upon whom he had operated during the past year for hæmorrhage from gastric or duodenal ulcers, as they may be of interest in connection with Doctor Hinton's paper later to be read.

The first case, a man, fifty-seven years old, admitted to St. Francis Hospital November 20, 1929, complaining of pain in the epigastrium. At first this had been relieved by taking food, but later food did not give relief. On February 4, 1924, the patient was operated upon by Doctor Russell at the Post-Graduate Hospital. At that time a large ulcer about the size of a twenty-five cent piece was found on the upper posterior surface of the first portion of the duodenum. The surrounding tissues were so infiltrated and œdematous that it was deemed unwise to attempt a subtotal resection at that time. After the gall-bladder had been dissected from the adherent duodenum it was removed in the usual way. An attempt was made to remove the ulcer by a transduodenal incision, but finding it impossible the base of the ulcer was cauterized. A posterior gastroenterostomy was performed at the junction of the proximal and middle two-thirds of the stomach. This site was selected in order that the distal half of the stomach could be removed at a subsequent operation if necessary. The appendix was also removed. Unexpectedly, this patient improved very much and while he did not gain appreciably in weight his general appearance was better and he admitted that he felt very markedly improved. However, it was necessary for him to consult Doctor Russell every few months on account of recurrence of gastric symptoms.

In the fall of 1927 he was riding through Central Park one evening when a taxicab collided with the one in which he was riding. Soon after the accident he felt very faint, went home and was put to bed. For several days he noticed black stools and all symptoms, which had been present three years previous to the operation, returned. Gastro-intestinal X-ray at that time showed a gastroenterostomy functioning well and also some of the meal passing through the pylorus. Doctor Imboden did not find any X-ray evidence of ulcer. With medical treatment and diet there was some improvement but every few weeks the old symptoms recurred. About the middle of November, 1929, he felt pain while sitting in his motor car and vomited a large amount of blood. On November 26, 1929, he entered St. Francis Hospital with hæmoglobin of 30 per cent. and had a transfusion of 600 cubic centimetres of blood by the Unger method. On December 2, 1929, with spinal anæsthesia Doctor Russell resected the distal half of his stomach and duodenum containing the scar of the former ulcer, which had healed, there remaining a minute ulcer from which it was evident that he had been bleeding. The distal end of the stomach was closed and the gastroenterostomy which had been made five years before retained. This operation really amounted to a Billroth II. Careful examination of the resected portion of the stomach revealed numerous areas of ulceration. On the third day after the operation pneumonia developed in the two lower lobes of the right lung and patient was extremely ill for several days. However, he recovered and has been free from all symptoms except a little gas to the present time.

The second patient, a man, fifty-three years of age, was admitted to St. Francis Hospital March 8, 1930. Six years ago had typhoid fever. Four years ago was operated upon by Doctor Russell at the Post-Graduate Hospital for duodenal ulcer. At that time the appendix was removed, a penetrating ulcer was excised and a posterior gastroenterostomy was performed. He had had ulcer symptoms for twelve years prior to this time. He states that he has been symptom-free until the present attack which began three weeks ago, at which time he fainted in the toilet early in the morning immediately after arising. He had no pain but vomited some mucus and passed tarry stools for several days. He was very weak but continued to work. Three days ago he again had a weak spell and began to pass tarry stools

which have continued to the present time. Hæmoglobin at the time of admission was 28 per cent. Appears very pallid and weak.

On March 10 he was given 620 cubic centimetres of blood by the Unger method of transfusion. On March 13 X-ray showed marked deformity of duodenal region. On March 17 a second transfusion of 500 cubic centimetres of blood was given him. Immediately following the transfusion, under spinal anæsthesia, the distal half of the stomach and first portion of the duodenum were excised. There were multiple erosions of the pylorus and duodenum found in the removed specimen. The gastroenterostomy which had been performed four years before was retained and the end of the stomach sutured. The pathologist reported numerous ulcerations about the pylorus and duodenum with areas of superficial hæmorrhages. The patient states that he is now feeling well and eats whatever he wants.

The third case presented was a man, twenty-six years of age, who was admitted to St. Francis Hospital November 3, 1929. At that time he stated that he had been a patient in same hospital for operation upon the stomach early in 1926 and again in autumn of 1927. The records showed that a duodenal ulcer was excised in 1926, and a posterior gastro-enterostomy had been performed in 1927. The chief complaint was pain in the epigastrium, slightly to the left side, one or two hours after meals. Until recently the pains had been relieved for a short while after meals. These pains have been present since leaving the hospital in 1927, but have become worse, especially at night, during the past week. He has frequently noticed that his stools have been very dark. X-ray report of November 8, 1929, shows a filling defect of the duodenum indicative of ulceration. There was also noticed retention of a small amount of barium at a point corresponding to the distal end of the gastroenterostomy opening. Diagnosis of marginal ulcer was made. Under spinal anæsthesia November 15 the abdomen was opened through the former scar and a large ulcer found encircling the distal third of the cloaca. The stomach and intestine were dissociated. The distal two-thirds of the stomach and scarred duodenum were excised. The cut end of the stomach was sutured to the opening in the intestine after the method of Polya. The patient was discharged December 14. He says that he is feeling very well but when seen ten days ago, which was the first time he has seen a doctor since leaving the hospital, he did not look well.

The fourth case presented was a young man, aged nineteen and a half years. He was admitted to St. Francis Hospital January 2, 1930, giving the following history:

Appendix was removed in same hospital two months ago. He still complains of epigastric pain which has not been influenced by the appendectomy. The pain begins two hours after meals and continues until the next mealtime. Pain is relieved by bicarbonate of soda which he has been taking for a long time. He has frequently noticed that his stools have been black. He has vomited frequently during the past few weeks but has not noticed any blood in vomitus. Gastro-intestinal X-ray showed a very large stomach low in the abdomen. The duodenal caput is small and irregular in outline suggesting ulceration. January 10, 1930, with spinal anæsthesia, a penetrating ulcer of the lesser curvature of the stomach was found 1½ inches to the inner side of the pylorus. The distal two-thirds of the stomach was removed after the method of Polya. A few weeks later this patient returned to the hospital and had his tonsils removed. He said he was then symptom-free.

## BLEEDING GASTRIC AND DUODENAL ULCERS. REPORT OF FIFTY-TWO CASES

DR. J. WILLIAM HINTON read a paper with the above title for which see page 844.

DR. JOHN F. ERDMANN said if one reviews the varied opinions that have been expressed during the past few years regarding this condition it will be clear that they have changed as often as those of ruptured tubal pregnancy cases. At one time these extrauterine patients were not treated until the bleeding had ceased. Of course, by that time some of the patients had also ceased, and this is the same with ulcer cases. With the advantages of transfusion, etc., of the present day an actively bleeding ulcer is, in the opinion of Doctor Erdmann, a surgical entity, a case for surgical interference. When one is satisfied by physiological examination of the blood, pulse, etc., that the hæmorrhage has ceased, the operative procedure can be delayed. He did not believe that the first hæmorrhage would always result in non-mortality, as had been stated so many times. For that reason, he took the stand that a case with rapidly increasing pulse and increase in the leucocyte count is a patient for active surgical treatment. It is not necessary to discuss the type of operation; it is enough to say that some operation is indicated. Doctor Erdmann wished also to affirm that the patient with recurring hæmorrhage is absolutely a surgical entity. The cause has not been removed if there are repeated hæmorrhages, although by the aid of the X-ray one can note if there is evidence of repair of the ulcer. There are today a number of surgeons and medical men walking about with ulcer of the stomach or duodenum, being watched very carefully by repeated X-ray examinations. If the X-ray shows the ulcer is diminishing the patient can remain under observation; if the ulcer is not diminishing in size or shows tendency to perforating or a dissecting evidence be found the patient immediately becomes a surgical entity. In regard to the frequency of perforations in the months of March and April and in October and November, Doctor Erdmann believed that careful observation on the part of anyone seeing many of these ulcer cases, will show that the greatest activity occurs in the spring and fall months. Certainly, in Doctor Erdmann's office, just as soon as a patient stated that he felt worse in the spring, or in the fall, it was felt that he had an active gastric or duodenal ulcer to contend with. In contemplating the figures of fifteen patients, with four deaths, in unoperated cases, and twenty-seven operations, with 16 per cent. mortality, one is driven to believe that the only thing to do is to consider the condition of the patient as he presents himself in the hospital. Every such patient has been bleeding for some time, and it is quite possible that there will be a cessation of the hæmorrhage at the time of admission. It is, therefore, not fair to estimate the patient's condition when he is first seen. Under observation it will be noted whether or not the hæmorrhage is persisting.

Dr. Frederic W. Bancroft said that he was very much interested at the present moment in the problem of six patients with bleeding who had died without operative interference. The speaker had held several discussions with physicians who declared they had never seen a patient die from gastric or duodenal hæmorrhage as such. He wished to ask Doctor Hinton what proof he had that his cases were solely duodenal or gastric ulcers and what diagnostic means were used.

Dr. William Crawford White inquired as to immediate operative interference in the acute cases, to what extent one should go in making a diagnosis of bleeding from an ulcer as such. It had been his unfortunate experience to operate on cases which were thought to be bleeding ulcer, but careful investigation failed to reveal any ulcer. To what extent should one go forward in such cases? If one waited for X-ray examinations and other data one then began to deal with a chronic case and by that time the chances were that the patient was recovering. It appears from the paper of the evening that the cases that died from hæmorrhage are those that have an overwhelming hæmorrhage with death shortly after the onset.

Dr. Kirby Dwight said that for years he had not been operating on these cases of bleeding from the stomach or duodenum unless there was indication for it after the hæmorrhage had stopped, and therefore had not had much opportunity to note the pathology of the stomach at the time of bleeding, but he remembered that as an interne under Doctor Blake these cases were operated on while actively bleeding and several that showed no pathology by palpation of the stomach, no induration, no crater, on opening revealed numerous small erosions, with no definite ulcer and no definite bleeding points that could be ligated.

Dr. Hermann Fischer said that active interference in cases of acute hæmorrhage was open to question and still a mooted point among surgeons. A correct diagnosis of the origin of the vomited blood is sometimes very difficult to make and the decision, whether one has to deal with hæmorrhage from the duodenum or stomach, or hæmorrhage of a different origin, becomes of the greatest importance. He had seen patients with severe bleeding in whom the diagnosis of gastric ulcer was made and in whom at operation no ulcer could be found. Several had multiple erosions so-called Reichmann's disease and some œsophageal hæmorrhage, and some hæmorrhage from the bowels secondary to venous congestion in the portal system. All these factors made him inclined to temporize. He had been rushed into operations which had proved without benefit; on the other hand, he had seen patients *in extremis* recuperate from the hæmorrhage and remain perfectly well, although in such cases he believed the hæmorrhage was caused by other pathology than ulcer. Doctor Fischer wished to accentuate the importance of making a diagnosis of the origin of the hæmorrhage, which is not so easy, especially in an emergency.

Dr. DeWitt Stetten said there has been a long-standing superstition among gastroenterologists that from a bleeding ulcer death never occurs and Doctor Stetten has heard this view stoutly maintained by some of the leading gastroenterologists of the country. The speaker has personally seen at least three such deaths confirmed by autopsy. In these cases there were large infiltrated ulcers on the lesser curvature or posterior wall of the stomach and in two of them a large patent artery could be seen at the base of the ulcer. The myth that death cannot occur directly from a gastric hæmorrhage due to a bleeding ulcer should be permanently exploded, because such deaths certainly do occur and are not so very uncommon.

Dr. Frank S. Mathews said that some years ago he encountered two ulcers while they were bleeding and, finding the general condition good, did a transfusion and immediate operation. The result was conspicuously successful. Encouraged by these cases, he followed the same technic of transfusion and operation in a case of fairly severe hæmorrhage. At the operation a long search through the upper abdomen failed to reveal the source of bleeding. In this patient, the bleeding has not recurred in over three years. He was more cautious in the next case. He treated the patient medically until health was restored. One year later the patient had another hæmorrhage. At operation, three weeks after the hæmorrhage, the pylorus was incised and no point of bleeding could be located. In the past year this patient's bleeding has not recurred. He wondered whether the bleeding point might not at times be from a fairly superficial ulceration even though the quantity of bleeding was considerable; and whether such a bleeding surface might not heal over in a fairly short time. In another case of gastric hæmorrhage, an incision into the body of the stomach revealed the point of bleeding in what looked like a fissure quite close to the greater curvature—a part of the stomach where one would not expect to find an indurated ulcer. He believes no single rule can be laid down to guide one in the selection of treatment in such cases.

Dr. Richard Lewisohn said that he did not agree with Doctor Hinton's statement that "it is very questionable whether partial gastrectomies are ever indicated in bleeding lesions, either of the stomach or duodenum." There can be no question that medical treatment of bleeding duodenal ulcer is followed by a considerable mortality. On the other hand, it cannot be denied that surgical intervention is not devoid of danger. Simple gastroenterostomy is not apt to cure a bleeding ulcer, and if any operation is performed partial or subtotal gastrectomy must be resorted to. The majority of bleeding ulcers are located on the posterior surface of the duodenum near the pylorus. Therefore, local excision is impossible in most of these cases. An attempt should be made in cases of duodenal ulcer to remove the ulcer. When dealing with a duodenal and gastrojejunal ulcer at the same time, and when the condition of the patient warrants it, it may be advisable to perform the Finsterer type of resection, a method that insures

a complete sidetracking of the food and a marked reduction in gastric acidity and thus facilitates healing of the ulcer of the duodenum. Conservative treatment should be attempted first in every case of acute bleeding ulcer. When the symptoms persist, however, surgery in the form of gastric resection must be resorted to in order to save the life of the patient, even in the presence of severe anæmia.

Doctor Hinton, in closing the discussion, said that autopsies were performed on all the cases that died under conservative treatment. In the cases of hæmatemesis and tarry stools the diagnosis of ulcer had been made either by X-ray, operation or autopsy, or from the previous history and treatment. If all the cases of gastro-intestinal hæmorrhage had been included in this series there would, in all probability, have been between 125 to 140 cases instead of the 52 cases reported. As to what method of treatment should be followed in cases of bleeding ulcer was difficult to decide, particularly when reviewing some of the cases reported that evening. One case, operated upon eighteen years ago, at which time gastroenterostomy had been done, was symptom-free from 1910 to 1928 and then had a profuse hæmorrhage. Another patient was treated for an ulcer and was symptom-free for twenty-five years and then had a gastric hæmorrhage. A third case first had a pyloroplasty for a bleeding ulcer and two years later a partial gastrectomy for pain, and two years after the second operation had a profuse hæmorrhage. Doctor Hinton said that his reason for stating that a partial gastrectomy seems very questionable in cases of bleeding ulcer was the information he had received within the past ten days that in Rochester, Minnesota, during the present year they have operated upon five cases of marginal ulcer following subtotal gastrectomy, all of these cases having originally been operated upon by the same surgeon in New York City.

# BRIEF COMMUNICATIONS

## MAGGOTS IN THE TREATMENT OF INFECTED WOUNDS, COMPLICATED FRACTURES, OSTEOMYELITIS AND TUBERCULOUS ABSCESSES

SINCE William S. Baer, of Johns Hopkins University, has revived in America the use of maggots (since 1928-1929) in the treatment of osteomyelitis, Kleinberg, of the Hospital for Joint Diseases, New York; Rechtman, of Philadelphia; Taylor, of Coatesville, Pa.; and others have been using this ancient remedy.

Cattell, editor of the International Clinics (Philadelphia), informs me he called attention to the unusually clean condition of battle wounds in France (1918) that were infested with live maggots. He discussed this interesting observation with men of Base Hospital No. 2.

D. P. Murphy, of Philadelphia, informs me (personal communication) that a friend told him that in 1866, a German doctor kept small tin boxes of maggots on his shelf. He put a box-full of live maggots in an infected wound of his hand and fingers (the result of an infected black spider-bite) and gave him (the patient) an equal amount of maggots to be used for redressing at bedtime. Fresh maggots were put in twice daily for ten days—using only dry gauze. The patient says it saved his fingers—which other surgeons had wished to remove. Since the German doctor was old then—in 1866—he must have been informed of Baron Larrey's work in the Napoleonic Wars. This patient, now eighty-four years of age, remembers the details most vividly. He recalls his doctor was very old and had palsy.

I will quote translating from Larrey's Clinique Chirurgicale, Paris, vol. i, pp. 51-52, 1829: "There is still a particular form of foreign body which should be considered. This form was observed by the author in most of the wounded soldiers in Syria during the Egyptian expedition. During suppuration of wounds, these wounded soldiers were inconvenienced by *larvæ of the blue fly*, common in that climate. These insects formed in several hours, developing with such a rapidity that in one or two days they were the size of a small quill. This greatly frightened the soldiers in spite of all efforts to reassure them. It was only after experience that they could be convinced that, far from being injurious to their wounds, *these insects accelerated cicatrization by shortening the work of nature and by producing an elimination of the necrotic cells by devouring them.* In fact, these *larvæ only* consumed putrid material and did not disturb any living tissues. No hæmorrhages were ever observed under these circumstances regardless of the depth to which the insects penetrated or the extent of the wound. Lotions consisting of a strong decoction of garlic, rue or sage applied at each dressing

sufficed to destroy them but they returned soon afterward on account of the lack of means for preventing the approach of flies or preventing incubation of the eggs. This can be accomplished by moistening the first compress in a solution of camphor or some other antiseptic fluid."

I have found no direct references to the use of maggots in the works of Guy de Chauliac (1340-1365), Henry de Mondeville (1330-1360) nor in Ed. Nicaise's Editions of Chauliac's and Mondeville's works (Paris). Some of the works of the following authors may contain such references but I have been unable to locate them: Ambroise Paré (1510-1590), Delacroix, Fallopius, Magatus, von Bilguer (1763), Paul of Aegina (7th Cent.), Rogerius (13th Cent.), Bouve (13th Cent.), De Vigo, Paracelsus, Vesalius (1514-1564), Le Dran (1730), Rivinus (1652-1723), Benjamin Bell (1749-1806), Astley Cooper, Heister, Percy, Lombard, Goulard, Sampson Gamgee, Richard Wiseman, and Pierre Franco (1561). Malgaigne (1847) does mention the value of maggots and quotes Larrey's observations. Packard in his translation, of course, mentions it (1859).

In "Selections from the Works of Ambrose Paré," by Dorothea Waley Singer, I find on page 84, line 18, under "Gunshot Wounds": "If any (wounds) chanced to bee undrest for one day—the next day the wounds would be full of wormes."

Jas. Henry Breasted's (1930) work on the Edwin Smith Surgical *Papyrus*, vols. i and ii (London, Cambridge University Press) makes no reference to maggots. Agnew's Surgery, vol. i, page 254, second edition, 1889 (Lippincott, Philadelphia) refers to maggots in wounds and how best to treat them.

I do not doubt but that the old Egyptian, Hindu, Indian and Arabian surgeons may have known of the value of maggots in the treatment of infected wounds and bone infections—but exact references are not available to me. It would be of interest from a historical standpoint to make a careful search of the ancient medical writings. I do not know of any Talmudic references to this subject.

W. W. Keen, of Philadelphia, says: "During the Civil War maggots were very common in the summer—the resulting maggots were certainly disgusting, but, so far as I ever observed, they did no harm." Crile (1917) says that, on the contrary, they actually do good. This would probably be especially true in cases of infection from the bacillus of gas gangrene.

Geo. W. Crile, speaking before the Clinical Congress of Surgeons of North America, "War Session," October 23, 1917, said: "In the wounded who lie out in 'No Man's Land' for two or five or ten days, it has been found that the wounds that have done best are those that contain maggots. The reason for this is that there is devitalised tissue; the maggots live on this devitalised tissue, and if they destroy that tissue they do in time what the surgical operation does."

Dr. Edward Martin, of Philadelphia, said (October 23, 1917) before the same session of the Clinical Congress of Surgeons of North America: "They

had been advised by one eminent member of the profession to take all the antiseptics and throw them into the sea, and another had advised them to raise a brood of tame *maggots to take care of the wounds.*"

In August, 1929, on a visit to the Provincial General Hospital of Madrid, Spain, I saw maggots being used in treatment.

There is a short article on this subject in Science, Supplement, p. 12, November 29, 1929.

HYMAN I. GOLDSTEIN, M.D.
*Camden, New Jersey.*

## THE UTILIZATION OF TWO OPERATORS WORKING SIMULTANEOUSLY ON THE SAME PATIENT

IT IS now a well-recognized fact that excessive speed in the performance of surgical operations is no longer the indication of the best surgery, but that moderate speed with greater consideration for tissues and attention to detail is much more desirable. Of course any manœuvre which will cut down the time of an operation and consequent length of anæsthesia is advantageous, so long as it does not interfere with careful work. The purpose of this note is to call attention to a plan which we have been using with a great deal of satisfaction and which doubtless others also use, or could use.

The reason for calling attention to this matter is that visitors observing our routine have remarked that the use of two operators working at the same time on the same patient was out of the ordinary. In general plastic surgery, we are constantly dealing with patients on whom two operative procedures may be carried out simultaneously on different portions of the body, and this may also be done in suitable cases in general and in orthopædic surgery.

For instance while one operator with his team is preparing an area to be skin grafted, the other can be cutting the Ollier-Thiersch, or whole thickness graft; while a part such as the hand is being made ready by one operator, a flap either for immediate transfer, or following a delayed transfer, can be prepared by the other.

Where fascia, or fat and fascia, or costal cartilage, or bone transplants are to be used, the areas into which they are to be transplanted can be prepared by one surgeon while the graft is being obtained by the other, etc., etc.

It is essential for the successful use of two operators that a competent and experienced associate be available who is familiar with the methods and needs of the surgeon in charge, and, of course, two operating teams are necessary.

I remember very well the first time the simultaneous use of two operators came to my attention. Many years ago while I was resident surgeon at the Union Memorial Hospital, a patient was admitted in Doctor Finney's service with bilateral gangrene of the feet. His condition was critical and immediate amputations were imperative, so in order to save time, Doctor

Finney asked me to remove one foot while he amputated the other. From this incident, with its evident advantage to the patient, developed the regular use of the method in my work.

Where two operative procedures which may be done at the same time on different parts of the body are necessary in order to accomplish the desired result, they should be done simultaneously.

For a number of years I have planned in advance for two operators and two teams on all cases where conditions are favorable and find it a great saving in operating time and much to the benefit of the patient. The procedure is particularly helpful in reconstructive work.

JOHN STAIGE DAVIS, M.D.
*Baltimore, Md.*

## CYSTIC MYOMA OF THE BROAD LIGAMENT

INTRALIGAMENTOUS cystic myomata are uncommon. Kelly and Cullen in their authoritative dissertation on uterine myomata state that in 1,600 of

FIG. 1.—Intraligamentous cystic myoma. External view.

their own cases of myomata they did not encounter any such type of growth. The records of Charity Hospital of New Orleans for the past twenty-four years fail to reveal the occurrence of any intraligamentous type of myomata.

Our search of the literature reveals only six such cases reported. This has prompted presentation of the present case.

CASE HISTORY.—Mrs. B. S., white housewife, age forty, was admitted complaining of pain in the lower abdominal segment for the previous eight months. The pain was dull in character and seemed more severe in the right lower quadrant than in the left. The past history revealed that an appendectomy had been performed fourteen years ago, but nothing of importance. *Physical Examination.*—Reveals nothing remarkable except a lipoma about the size of a small orange in the lumbar region on the left side, and tenderness in the lower portion of the abdomen. Vaginal examination reveals a hard mass to the right of the normal position of the uterus. This mass is tender and seemingly movable with the uterus.

Under gas anæsthesia, a mid-line incision was made between the umbilicus and the pubis. The intestines and omentum were packed upward with large gauze packs. The

FIG. 2.—Intraligamentous cystic myoma surfaces revealed by sectioning.

uterus was found to be small, its right lateral aspect over-riding a tumor slightly oblong in shape, nodular, about the size of a large orange, and situated within the folds of the right broad ligament. A pedicle carrying two or three small blood-vessels apparently was the only connection existing between the tumor and the myometrium. The folds of the broad ligament were incised and the tumor mass enucleated. During this enucleation, there was hardly any bleeding as practically all of the blood supply came from the vessels entering through the pedicle. The pedicle was clamped, severed from the tumor mass and ligated with chromic No. 2 catgut. The folds of the broad ligament were closed with chromic No. 1 catgut. There being no bleeding and the appendix having been removed at a previous operation, the packs were removed and the incision closed in the usual manner by layers.

*Gross Observation of Removed Tumor.*—The specimen consists of a mass of tissue generally rounded in shape (Fig. 1), measuring 9.5 by 7.25 by 6 centimetres. Externally, the tumor is markedly nodular, grayish-pink in color and devoid of peritoneum. At one point there appears a small pedicle containing three or four small blood-vessels with a plexiform arrangement of these vessels at their point of entry and exit in the tumor. Here and there small cysts can be noted beneath the surface. Surfaces presented by sectioning (Fig. 2) reveal a pinkish-gray color with a whorl-like arrangement of

myomatous tissue, the tumor being markedly lobulated with cysts varying in size from a few millimetres to 0.5 centimetre in diameter occurring throughout. The cysts contain clear, straw-colored, mucoid material.

*Discussion.*—The intraligamentous myomata previously reported all occurred on the left side. Eden, A. J. Smith, and Langley found only a few strands of tissue existing between the tumor mass and the uterus. In Janicot's and A. L. Smith's cases, distinct connection between the myomatous tumor and the uterus could be demonstrated. All of the growths were within the folds of the broad ligament and were readily removed. In Langley's case, it was necessary to dissect out the left ureter in order to properly control all bleeding. In addition, this case showed a small subperitoneal myoma on the posterior uterine wall. In A. J. Smith's, A. L. Smith's and Rosenberg's cases, the tumors had caused dissection of the posterior peritoneal covering of the uterus into the broad ligaments of the opposite side.

The gross and microscopic structural similarity of the various tumors is marked. They consisted of masses of myomatous and fibrous tissue with interspersed multiple cysts, some being microscopic in size, others rather large. Retrograde changes were prominent. Janicot alone found epithelium lining in the cyst-like cavities, one such cavity in the body of the tumor being so lined. In all cases some connection, even though at times slight, could be noted between the uterine body and the tumor. We subscribe to the belief that such growths spring from the uterine body and not from the smooth muscle fibres normally present in the broad ligament as believed by Eden and A. J. Smith.

ARTHUR VIDRINE, M.D., and RIGNEY D'AUNOY, M.D.
*of New Orleans, La.*

*From the Departments of Surgery and Pathology of the Charity Hospital and the School of Medicine of Louisiana State University.*

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# TUBERCULOSIS OF THE DUODENUM, LIMITED TO THE PAPILLA OF VATER*

TUBERCULOSIS of the duodenum seems to be even more uncommon than that of the stomach. In 5,900 autopsies, including 2,360 with evidences of tuberculosis elsewhere, Goosman found it but five times, either alone or as part of a general intestinal involvement. The reason for this rarity is not clear, although it has been thought to be connected with the antiseptic properties of the gastric, pancreatic and biliary secretions. The bile, however, may perhaps be excluded by the fact that the tuberculous ulcer in the case here reported was situated around the opening of the common bile duct—apparently a unique observation. It also is interesting to note that the trouble has been found where there was little if any acid in the stomach. Clinically only six cases have been reported according to Röpke,[1] four in men and two in women, two of these being over fifty years of age.

The most likely source of infection is thought to be by way of the stomach, possibly upon the basis of an old duodenal ulcer, although consideration must be given to the blood-vessels and the lymphatics, especially those connected with diseased retroperitoneal glands. In the case here reported a tuberculous lymph node was found, but it was the only one and seemed obviously secondary to the duodenal ulceration. In nearly all instances the duodenal lesion has been secondary to tuberculosis elsewhere, although Höfer has reported one that was primary and my own case appears to be of that nature. The ulcers nearly always are situated in the proximal portion of the duodenum, but they may appear elsewhere.

There seems to be little that is characteristic about the symptoms, which may, indeed, resemble closely those of ordinary ulcer. There is frequently, however, a tendency to stenosis, which, in connection with diarrhœa and the manifestations of ulcer may, according to Röpke, arouse suspicions of tuberculosis; but an exact diagnosis is difficult if not impossible. In spite of its rarity, however, the possibility of tuberculosis should be borne in mind in gastroenterostomies for ulcer of the duodenum, especially when the ulcer refuses to heal.

The treatment suggested by Röpke is resection of the affected portion of the duodenum when practicable (three cases reported), followed by the use of the X-ray and heliotherapy. These latter measures, however, would seem to be uncalled for if the operation has been a thorough one, the excision of the ulcer alone, together with infected lymph nodes, perhaps being sufficient, as in the instance under consideration.

CASE REPORT.—The patient was a thin, moderately jaundiced woman, fifty-two years of age, without pain, tenderness or attacks of colic, who had lost about 100 pounds in weight. The jaundice had existed for two years, and was subject to irregular variations in intensity. There were indefinite stomach symptoms, with a tendency to nausea, and vomiting an hour or so after meals. Some sixteen months previously a cholecystectomy had been done, but no improvement resulted except relief from a certain amount of pain.

* Read before the Western Surgical Association, December 5, 1930.

The stools were clay-colored. No blood had been vomited or passed by the bowel. Since this operation, she has had frequent attacks of persistent diarrhœa. One sister had suffered with pulmonary tuberculosis, but there was no history of the trouble in the remainder of the family or in herself, and no signs of pulmonary or other tuberculous foci could be detected. Bleeding time 2½ minutes; clotting time 5 minutes; hæmoglobin 70 per cent. An X-ray examination was negative, including the stomach.

At an exploratory operation done September 2, 1929, under a diagnosis of obstructing stone or tumor, a greatly dilated common duct was found. The liver was swollen and congested, with rounded edges, but there was nothing abnormal about the stomach or pancreas and no tumor was detected. Exploration of the duct revealed an impassable stricture at its orifice, but no stone. The duodenum was then opened with a transverse incision and an ulcer exposed surrounding the papilla of Vater. It was about the size of a little finger nail, somewhat raised above the surface, almost like a sessile papilloma, and was soft and vascular, with the opening of the bile duct in its centre. There were no other lesions of the mucosa. Exactly in the angle between the common duct and the duodenum, and in intimate relation with the ulcer, was a solitary caseous lymph node the size of a small olive, which may have contributed to the biliary obstruction.

The ulcer was excised, together with small terminal portions of the common and pancreatic ducts, the openings of which were then stitched to the surrounding mucous membrane. After removal of the caseous gland, a choledochoduodenostomy was done in order to insure a free outflow of bile if a stricture should form. The incisions in the duodenum and common duct were then closed, the suture lines covered with omental tags, and a temporary drainage tube inserted in the foramen of Winslow, which was removed in four or five days. There was no leakage of bile and the convalescence was uneventful, except for a rather troublesome post-operative diarrhœa lasting for a week or so. The jaundice existing at the time of operation soon disappeared and the return of health and strength was rapid, the patient reporting, some eleven months later, that she had gained enormously in weight and felt perfectly well. The laboratory report on the specimens removed was tuberculosis of both lymph node and ulcer.

LEONARD FREEMAN, M.D.
*Denver, Colo.*

[1] Röpke: Beitrag zur Klinik der Tuberculose des Zwölffingerdarmes und der Magen. Bruns Beitr. z. Klin. Chir., B. 144, S. 453, 1928 (Literature).

## CORRIGENDA

In the January number, p. 430, 23d line from top, for the figures "160" substitute "60"; p. 431, 15th line from top, for "figure 5" substitute "5%"; p. 434, 9th line from bottom, insert word "with" after word "while," so as to read "while with others, etc."

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